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R.B.
7/13



46050 Manekin Plaza ■ Suite 100 ■ Sterling, Virginia ■ 20166

703 ■ 444 ■ 7000 703 ■ 444 ■ 1685 FAX

GROUNDWATER MONITORING PLAN

WINNEBAGO RECLAMATION LANDFILL
ROCKFORD, ILLINOIS

VOLUME I — REPORT

Prepared for:

Winnebago Reclamation Services, Inc.
Rockford, Illinois

July 1995





46050 Manekin Plaza • Suite 100 • Sterling, Virginia • 20166

703 • 444 • 7000 FAX: 703 • 444 • 1685

November 16, 1995

VIA EXPRESS MAIL

Mr. Thomas Hilbert
Environmental Engineer
Winnebago Reclamation
8403 Lindenwood Rd.
Rockford, IL 61109

Subject: Corrections to the Pagel Landfill Application for "Significant Modification" of the existing Permit, Log No. 1995-250
GeoTrans Project No. 7740-007

Dear Tom,

Enclosed please find the formal response to those items in the application that require correction or additional information to satisfy IEPA comments. The response addresses the comments specified in the IEPA letter dated October 6, 1995 and discussed during the meeting on October 24, 1995. To this end, four reports have been modified: (1) Groundwater Management Zone Application; (2) Groundwater Impact Assessment; (3) Groundwater Monitoring Plan; and (4) Groundwater Remedial Alternative Analysis and Preliminary Design (Air Sparging). The latter has been revised to include an evaluation of remedial alternatives and is now entitled "Corrective Action Measures Assessment and Preliminary Design."

The following replacement pages should be inserted into each respective document to address the comments or reflect changes in pagination.

Groundwater Management Zone Application:

1. Replace Table of Contents pages ii and iv,
2. Replace pages 10 through 14 and 28, and
3. Insert Attachment 1 and associated Figures A1 through A6 at page 32.

Mr. Tom Hilbert

2

November 16, 1995

Groundwater Impact Assessment:

1. Replace Table of Contents pages ii and v,
2. Replace text pages 24, 30, 31, 90, 91, 92, 93, 95, and 96, and
3. Insert Attachment 1 (pages 97-99).

Groundwater Monitoring Plan:

1. Replace Table of Contents pages ii and v and
2. Replace pages 1, 2, 13, 14 (Figure 3.1), 15, 16, 17 (Figure 3.2), 23, 24, 26, 33-36, and 40-59.

Groundwater Remedial Alternative Analysis and Preliminary Design (Air Sparging):

1. This document has been revised for IEPA and is entitled "Corrective Action Measures Assessment and Preliminary Design."

If you have any questions or need clarification, please do not hesitate to contact me at (703) 444-7000.

Sincerely,



Alex Vincent
Senior Hydrogeologist

av/AV

enclosures: as stated

cc: D. Feezor (Andrews) for C. Liebman, IEPA (w/encl. - 4 copies)
B. Schorle, USEPA Region 5 (w/encl. - 2 copies)
R. Rajaram, PRC Environmental (w/encl. - 1 copy)
D. Burnell, GeoTrans (w/encl. - 1 copy)
P. Rich, GeoTrans (w/encl. - 1 copy)



46050 Manekin Plaza • Suite 100 • Sterling, Virginia • 20166

703 • 444 • 7000 FAX: 703 • 444 • 1685

July 7, 1995

Mr. Bernard J. Schorle
United States Environmental Protection Agency
Region V
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Reference: Reports for the Significant Modification Permit Application
GeoTrans Project No. 7740-000

Dear Mr. Schorle:

GeoTrans, Inc. is pleased to provide you with two copies of the following reports:

1. Report of Hydrogeological Investigations at the Existing Facility
2. Groundwater Impact Assessment Report at the Existing Facility
3. Groundwater Monitoring Plan
4. Groundwater Management Zone Application
5. Groundwater Remedial Alternative Analysis and Preliminary Design (Air Sparging)
6. Construction and Calibration of a Three-Dimensional Numerical Groundwater Flow Model

We look forward to your review of the report.

Should you have any questions, please feel free to call me at (703) 444-7000.

Sincerely,

Daniel K. Burnell, P.G.
Senior Hydrogeologist

DKB/eb

Enclosure: as stated

cc: Raj Rajaram, PRC Environmental Management, Inc.
Thomas Hilbert, Winnebago Reclamation Service, Inc.
Daniel R. Feezor, Andrews Environmental Engineering, Inc.

GROUNDWATER MONITORING PLAN

**WINNEBAGO RECLAMATION LANDFILL
ROCKFORD, ILLINOIS**

Prepared for:

**Winnebago Reclamation Services Inc.
Rockford, Illinois**

Prepared by:

**GeoTrans, Inc.
46050 Manekin Plaza, Suite 100
Sterling, Virginia 20166**



GeoTrans Project No. 7740-005

June 19, 1995

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1 INTRODUCTION

Winnebago Reclamation Landfill (WRL) is an existing landfill that is subject to regulation by Title 35 Illinois Administrative Code (IAC) Section 811.318 and 811.319. This document was prepared to provide a Groundwater Monitoring Plan (GMP) in accordance with 35 IAC 811.318-319. The GMP is being submitted concurrently with the Groundwater Impact Assessment (GIA) as part of the significant permit modification application for the existing WRL in accordance with 35 IAC 814.302(a)(5).

Concurrently, the WRL site is subject to remediation mandated by a Consent Decree under the Comprehensive Environmental Responsibility, Compensation and Liability Act (CERCLA) and remediation required by 35 IAC 811. Consequently, this GMP includes a description of the monitoring well networks and monitoring programs for Operation and Maintenance monitoring (a continuation of the assessment monitoring program), Verification monitoring, and Detection monitoring. These programs were included in this GMP, because there is the potential that each of the programs may be needed during the five-year permit life. A more detailed description of the Operations and Maintenance (O&M) monitoring program is provided as this is the first of the aforementioned monitoring programs that will be required during the permit term. The O&M monitoring program is an assessment monitoring program designed in accordance with 35 IAC 811.319(b)(5)(D&E).

This report first provides an overview of the hydrogeologic conditions at the WRL site. Using a calibrated groundwater flow model, particle tracking was used to demonstrate that the background monitoring wells are appropriate upgradient monitoring wells for the WRL site. This document then discusses the establishment of the background concentration values for each leachate constituent in groundwater. An O&M monitoring program which is a continuation of assessment monitoring performed previously is proposed to assess the effectiveness of the proposed remedial action and to determine if groundwater cleanup objectives are being met. Finally, semi-analytical transport modeling was performed to determine appropriate well spacing for the verification and detection monitoring network.

As part of the application for a significant modification under 35IAC 814.302(a)(5), a groundwater management zone (GMZ) designation is being requested in accordance with the provisions of 35IAC 620.250. It is understood that because the planned groundwater remediation qualifies as an IEPA approved action in accordance with CERCLA , such designation is reasonable and appropriate for this situation. The GMZ application will be submitted under separate cover.

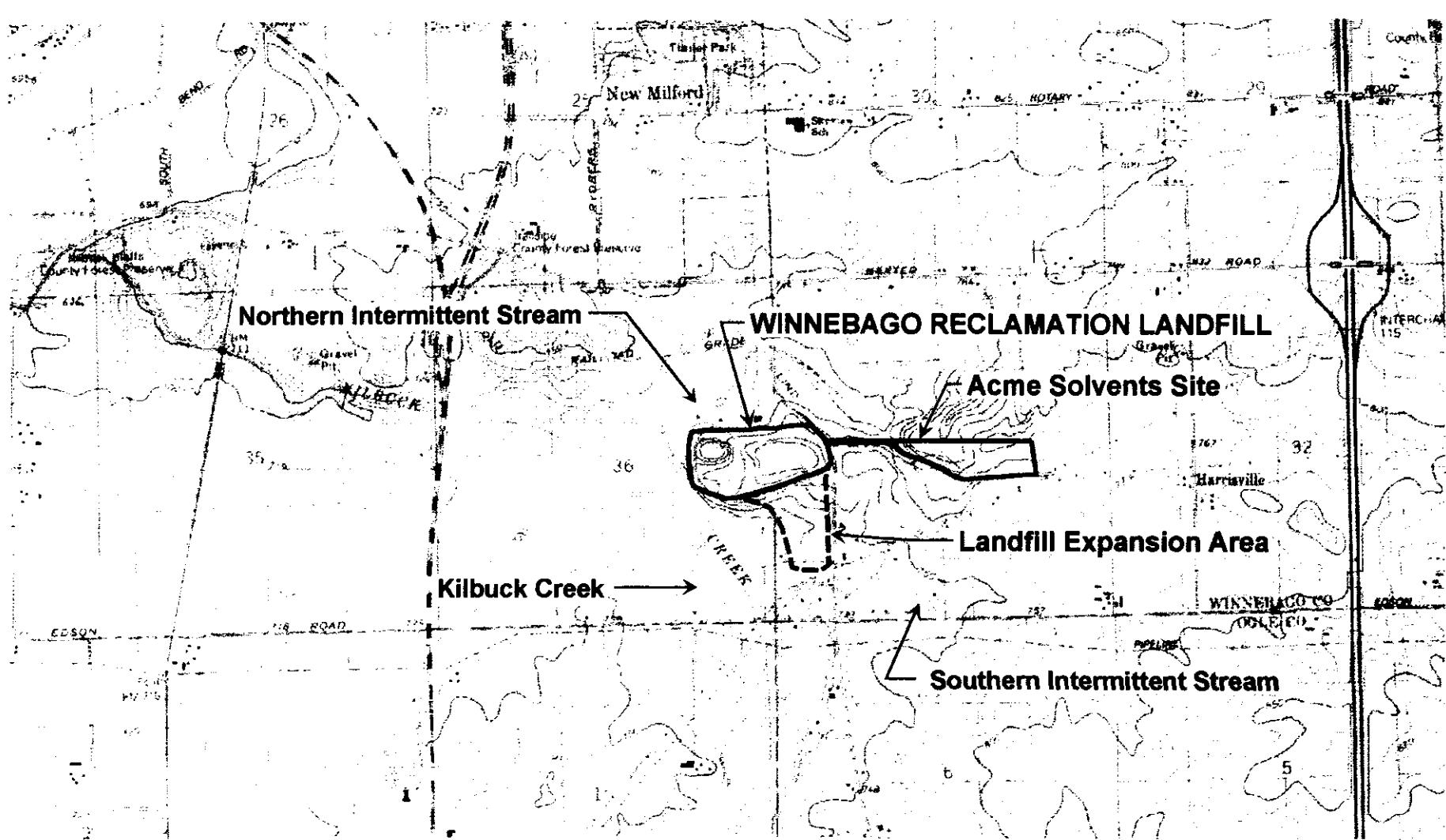
2 SUMMARY OF HYDROGEOLOGIC CONDITIONS

The WRL site is located approximately five miles south of Rockford, Illinois.

Figure 2.1 shows that the site is situated on a topographic high between Kilbuck Creek to the west and unnamed intermittent streams to the north and south. The surficial unconsolidated sediments at the site are predominantly glacial drift overlying dolomite bedrock. The unconsolidated deposits consist of a thin veneer of sediments to the east near Acme Solvents, and increase in thickness to the west due to the presence of a major bedrock valley.

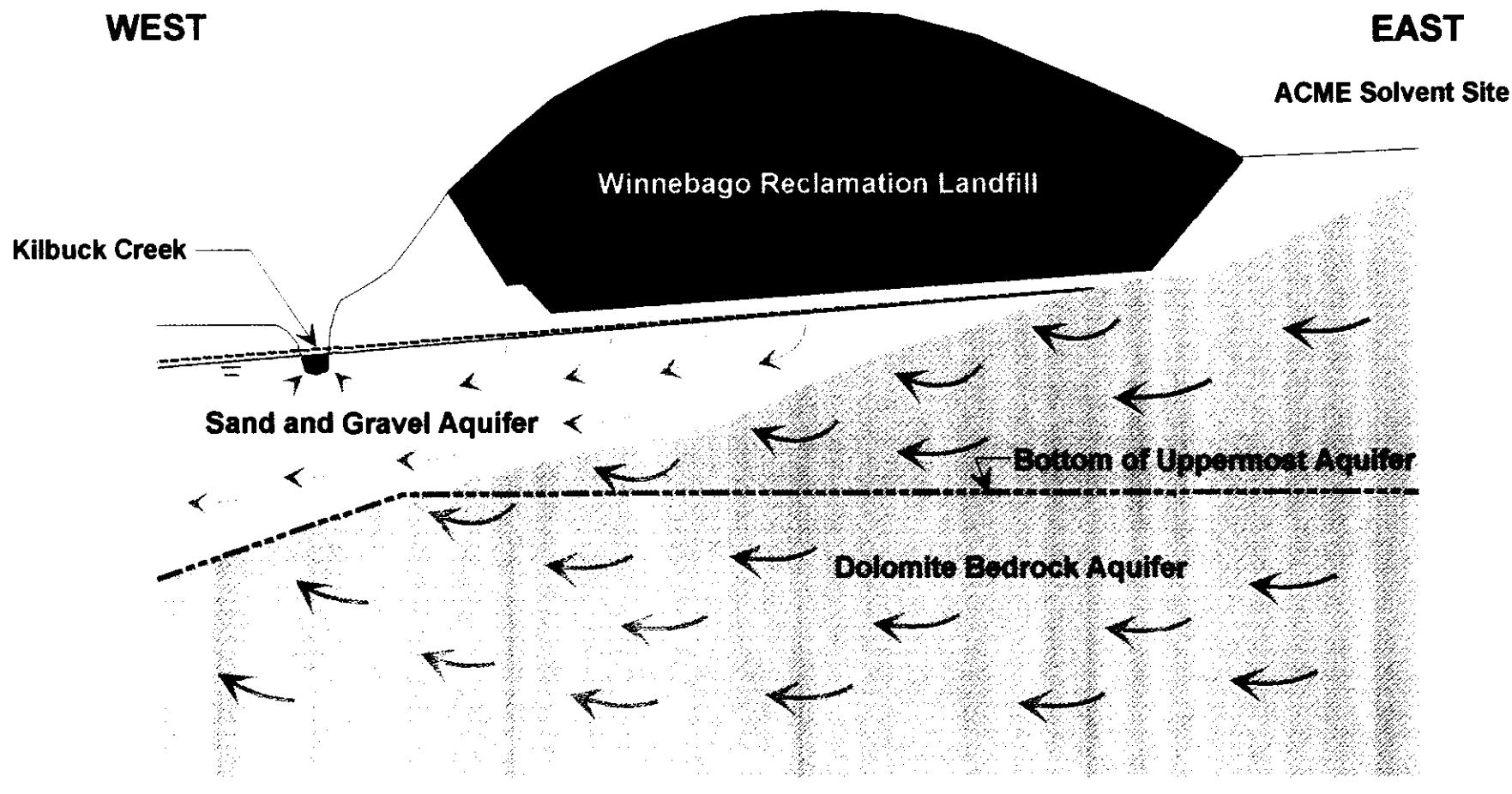
A high permeability, unconsolidated sand and gravel aquifer and lower permeability dolomite bedrock aquifer form the aquifer system beneath the WRL Site. Figure 2.2 shows a generalized east-west trending cross section of the aquifer system beneath the WRL site. As discussed in detail in the Report of Hydrogeological Investigation (GeoTrans, 1995c), the uppermost aquifer is defined to consist of both the sand and gravel aquifer and shallow bedrock. Potentiometric surface maps show that groundwater flows generally to the west-northwest (GeoTrans, 1995c). In general, the aquifer system is recharged in the bedrock uplands with groundwater flowing downward in this area and later flowing back upward into the higher permeability sand and gravel sediments. Shallow groundwater in the unconsolidated sediments discharges to Kilbuck Creek while deeper groundwater flows beneath Kilbuck Creek and continues toward the west-northwest.

In order to fully delineate impacted groundwater in the vicinity of the WRL site, an extensive field investigation was performed with four new monitoring well clusters (G33S/G33D, G34S/G34D, G35S/G35D, G37S/G37D) installed in the upper and lower zones of the unconsolidated sediments in March 1995. Additionally, monitoring well G36 was installed west of the landfill. Figure 2.3 shows a monitoring well location map for the WRL site which includes these newly installed wells. These new well clusters enabled WRL to prepare potentiometric surface maps of the upper and lower parts of the sand and gravel



NOTE:
BASE MAP DEVELOPED FROM ROCKFORD SOUTH, ILLINOIS
7.5 MINUTE USGS TOPOGRAPHIC QUADRANGLE MAP
FIELD CHECKED IN 1992. MAP EDITED IN 1993.

TITLE		
SITE LOCATION MAP		
LOCATION	Winnebago Reclamation Services, Rockford, IL.	
GeoTrans, inc. GROUNDWATER SPECIALISTS		FIGURE 2.1
CHECKED	D.B.	
DRAFTED	P.K.	
FILE	7736001A.DS4	
DATE	6-10-95	



Legend

- sand and gravel potentiometric surface
- - - bedrock potentiometric surface
- — — bottom of uppermost aquifer

Not drawn to scale

TITLE

**GENERALIZED CROSS SECTION OF HYDROGEOLOGIC
CONDITIONS AT THE WRL SITE**

LOCATION

Winnebago Reclamation Services, Rockford, IL.

GeoT
trans, inc.
GROUNDWATER SPECIALISTS

CHECKED

D.B.

FIGURE

DRAFTED

P.K.

FILE

7735001A.DS4

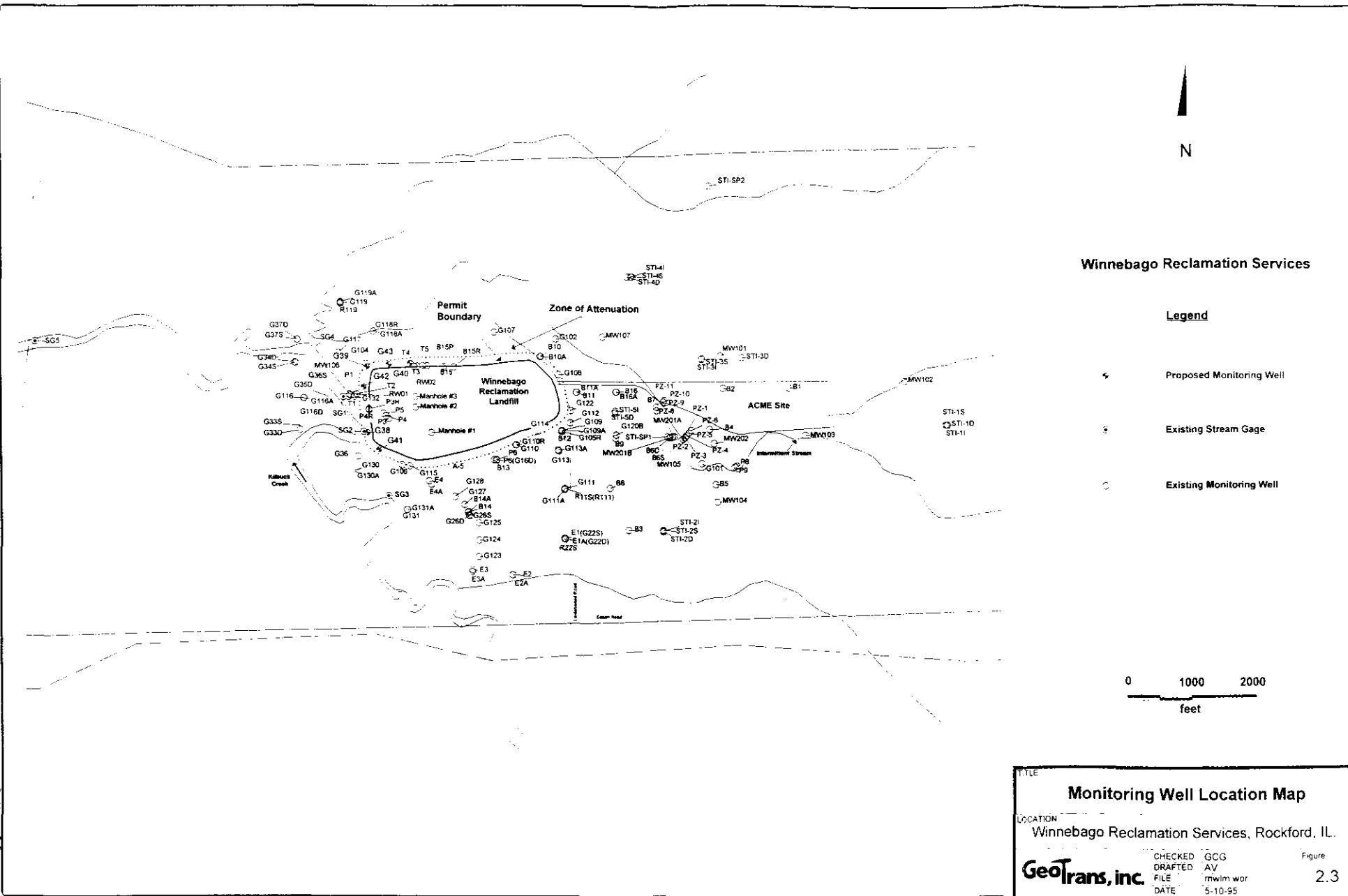
DATE

6-26-95

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aquifer. Soil logs and well construction diagrams are shown in the Report of Hydrogeological Investigations (GeoTrans, 1995c).

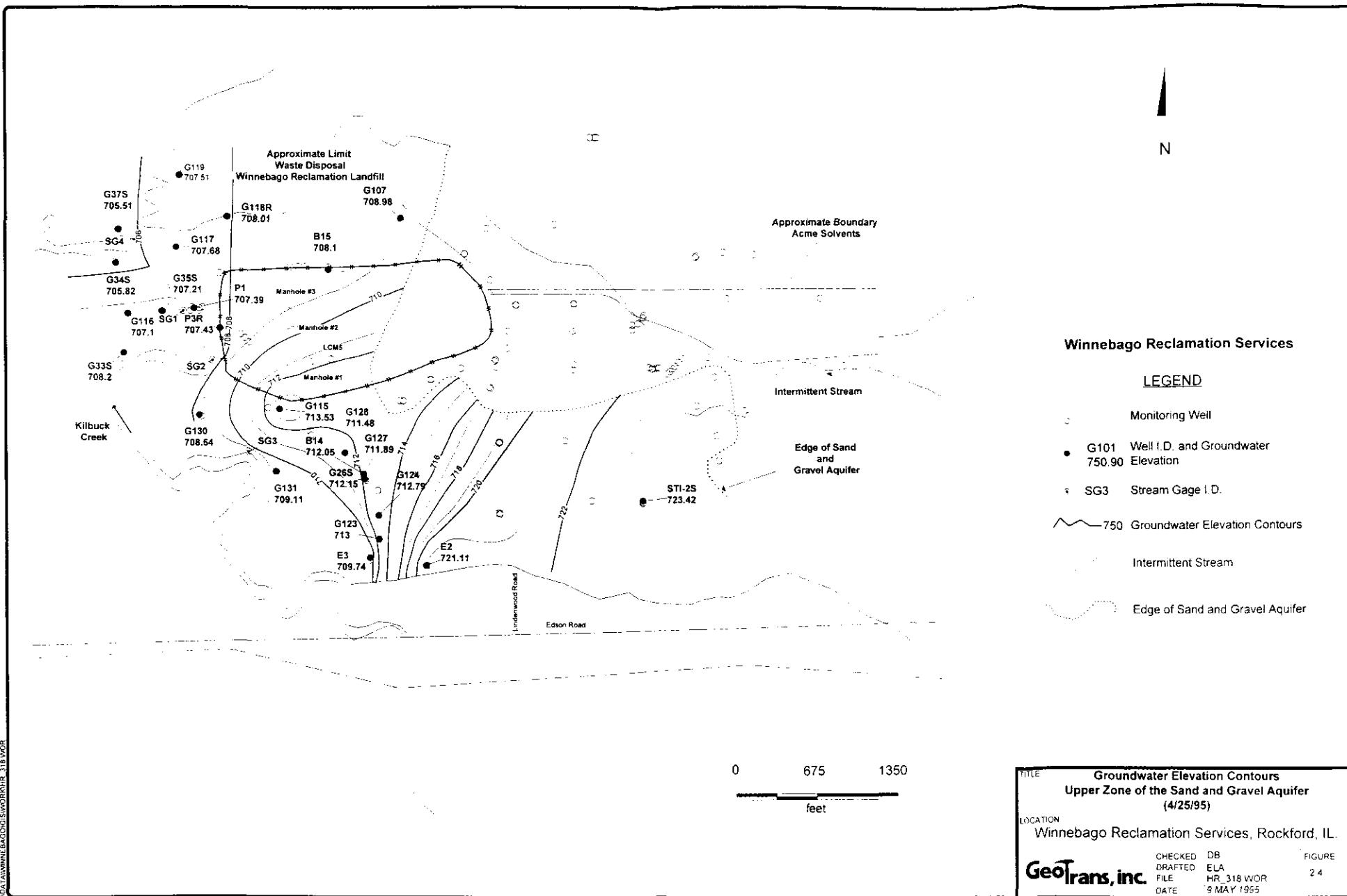
Figures 2.4 through 2.6 show groundwater elevation contour maps for the upper part of the sand and gravel aquifer, lower part of the sand and gravel aquifer, and the dolomite bedrock aquifer, respectively, based on water level data collected on April 25, 1995. These figures show that groundwater flows to the west-northwest throughout the unconsolidated sediment-bedrock aquifer system. Upgradient and to the east where only the bedrock is saturated, groundwater elevations show that groundwater flow direction is downward. However, in areas where the unconsolidated sediments are saturated, groundwater elevations show that shallow bedrock groundwater flows upward into the unconsolidated sediments.

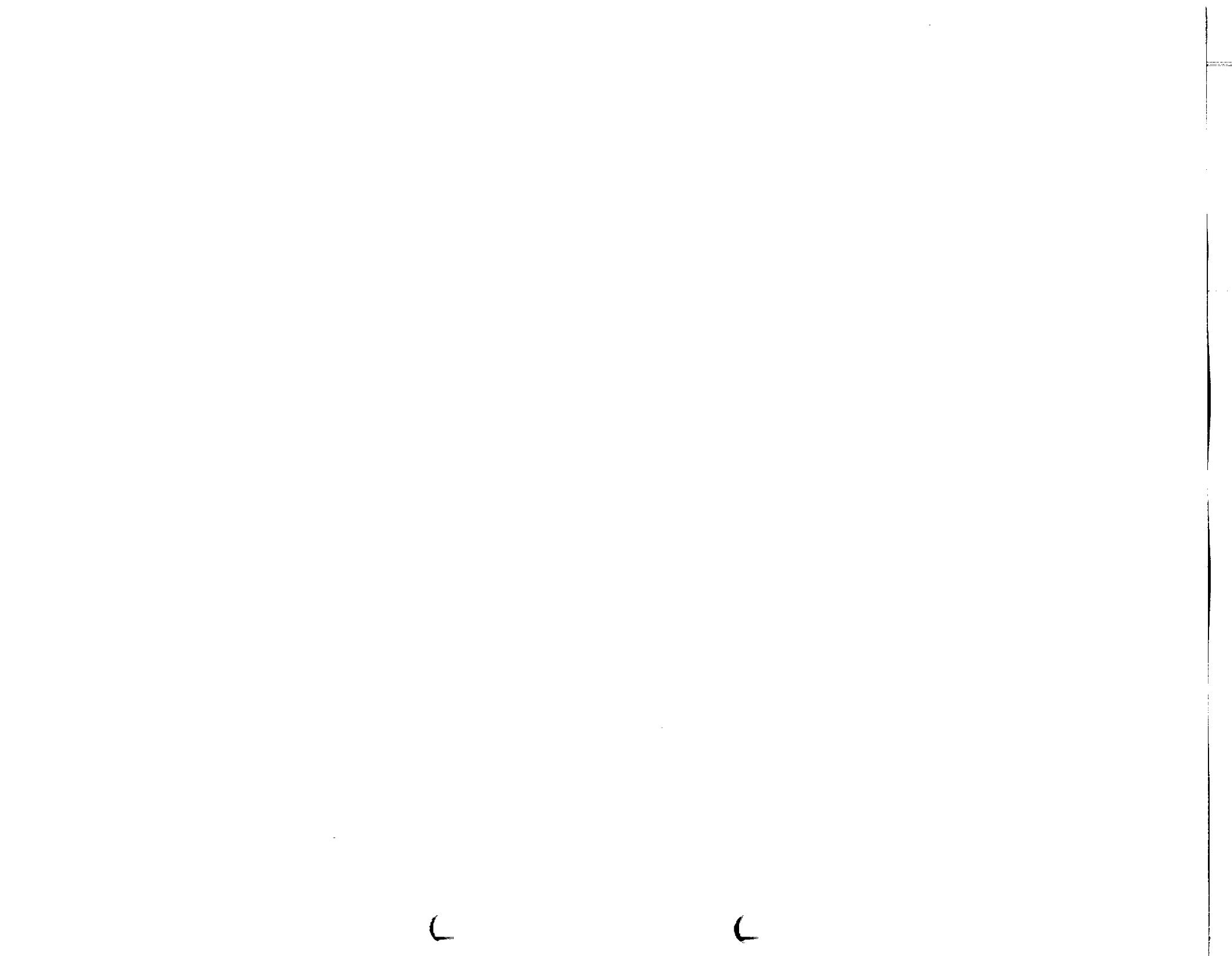
As part of the remedial design for impacted groundwater at the WRL site, a groundwater flow model was constructed and calibrated to water levels measured on February 17, 1995. The numerical groundwater flow code MODFLOW (McDonald and Harbaugh, 1988) was used to simulate current groundwater conditions at the WRL site. The conceptual hydrogeologic model, model construction, calibration, and verification are discussed in detail in the groundwater flow modeling report (GeoTrans, 1995a).

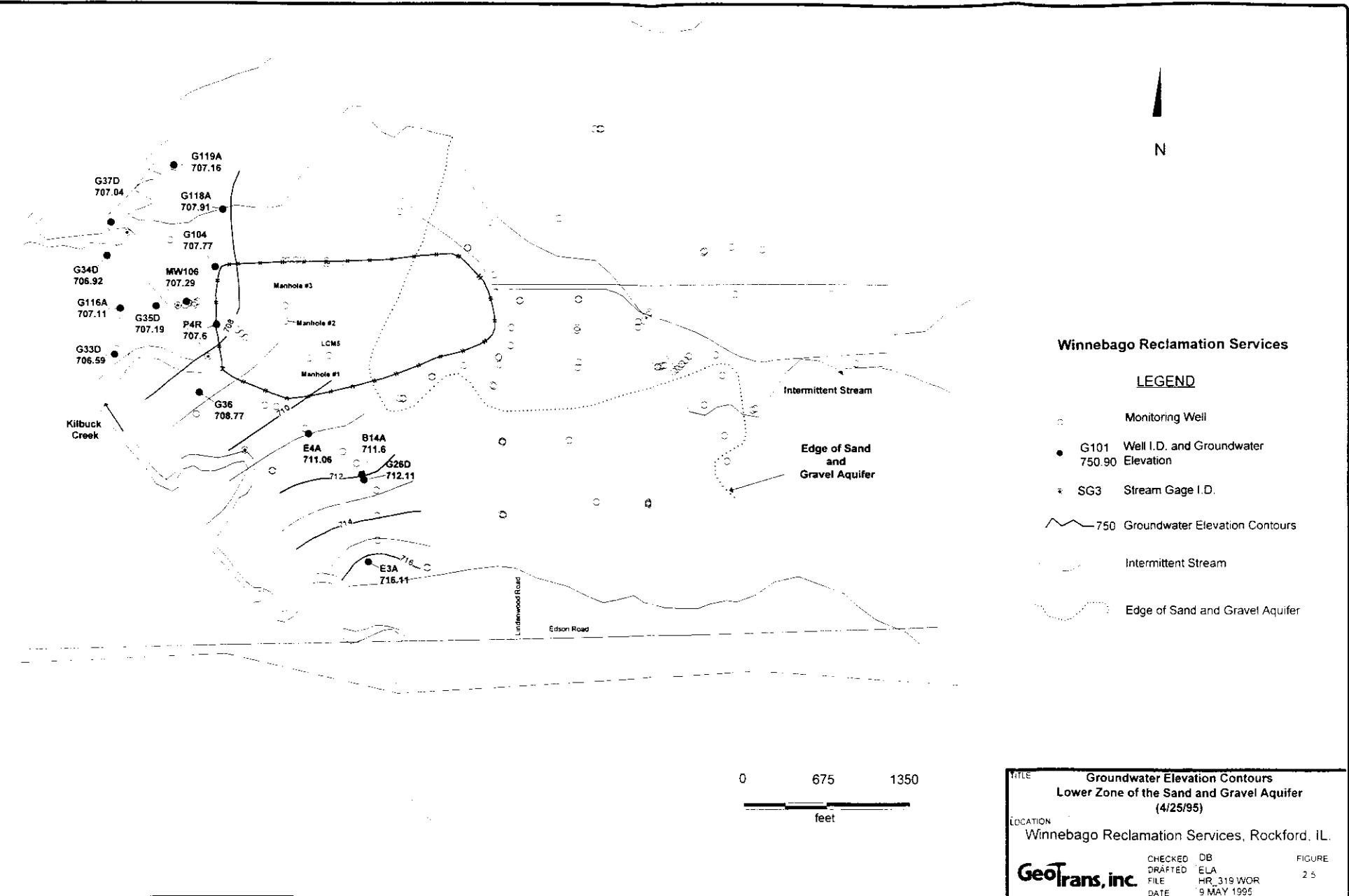
In order to better understand groundwater flow rates and flow directions at the WRL site, the U.S. Geological Survey particle-tracking code MODPATH (Pollock, 1989) was used. Particle tracking is a simple form of contaminant transport analysis which disregards the effects of dispersion, retardation, and chemical reactions. Using an initial starting point, forward particle tracking simulates the downgradient movement of a particle through a groundwater velocity field over time. Using steady-state groundwater flow rates simulated from MODFLOW, MODPATH computes groundwater velocities in the three principal coordinate directions throughout the model domain. To compute these velocities, MODPATH requires site-specific values of effective porosity for each node in the model domain. The estimated value of porosity for the unconsolidated sediments was 0.3 based on laboratory tests and 0.1 for the bedrock based on lithology (de Marsily, 1986).

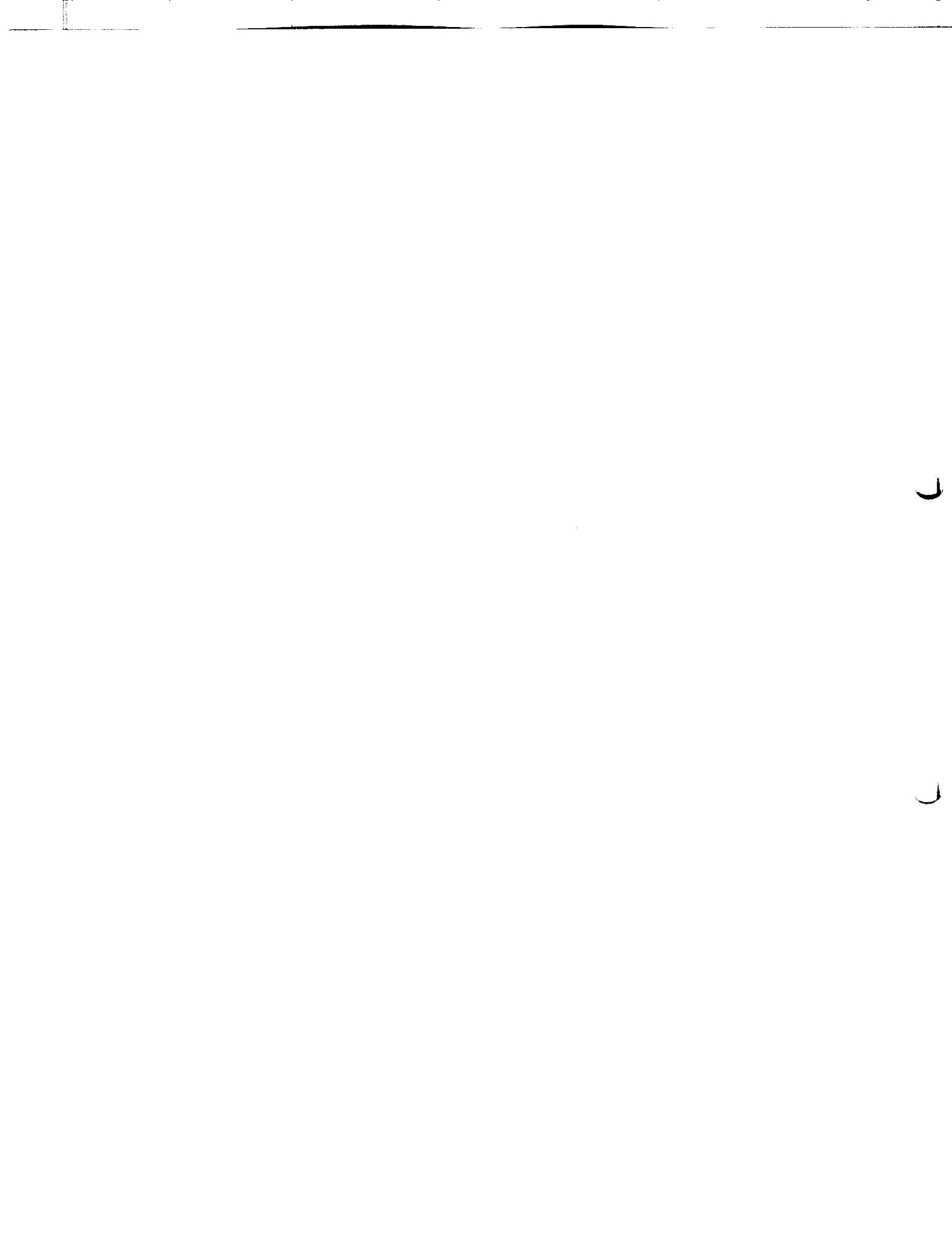
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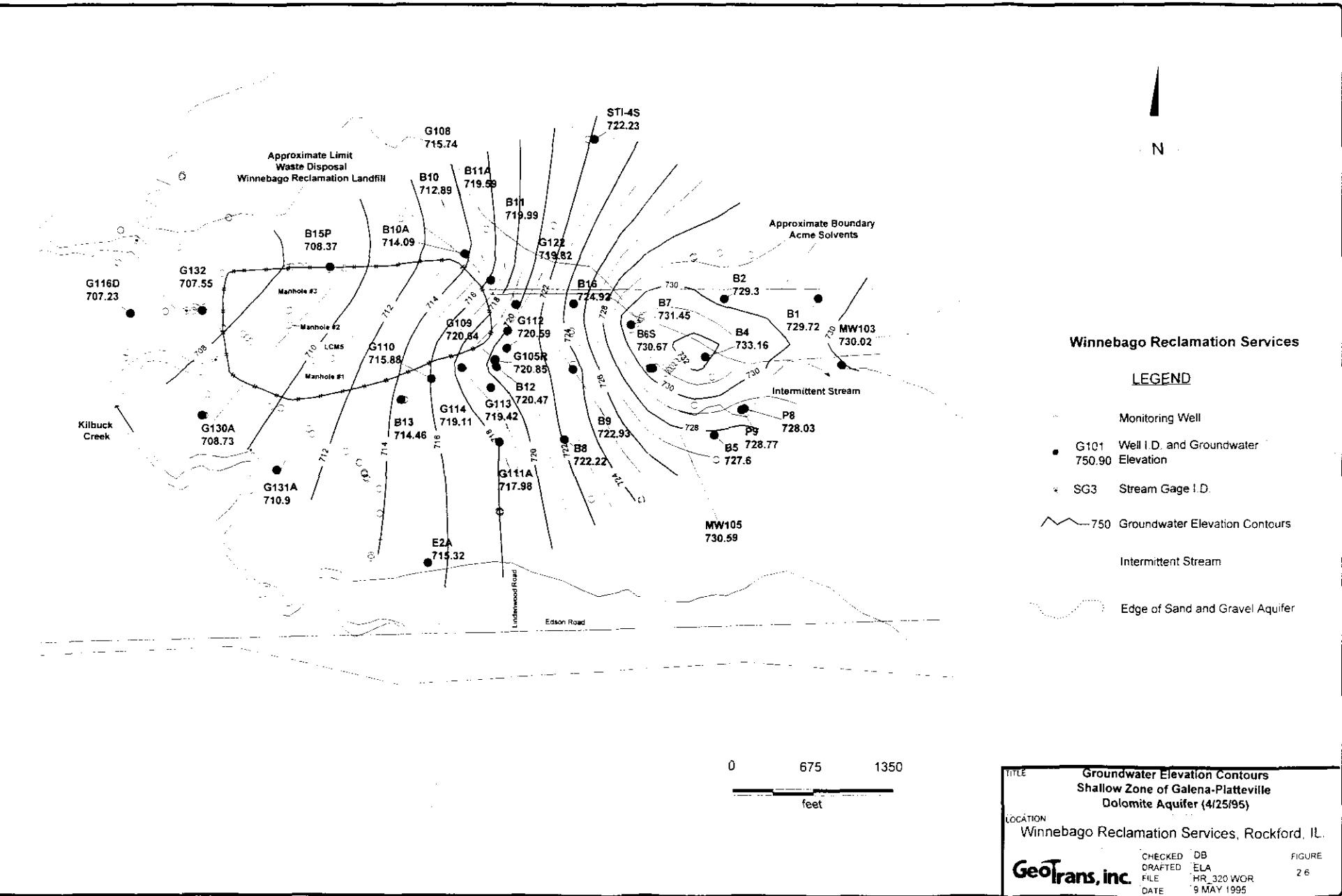
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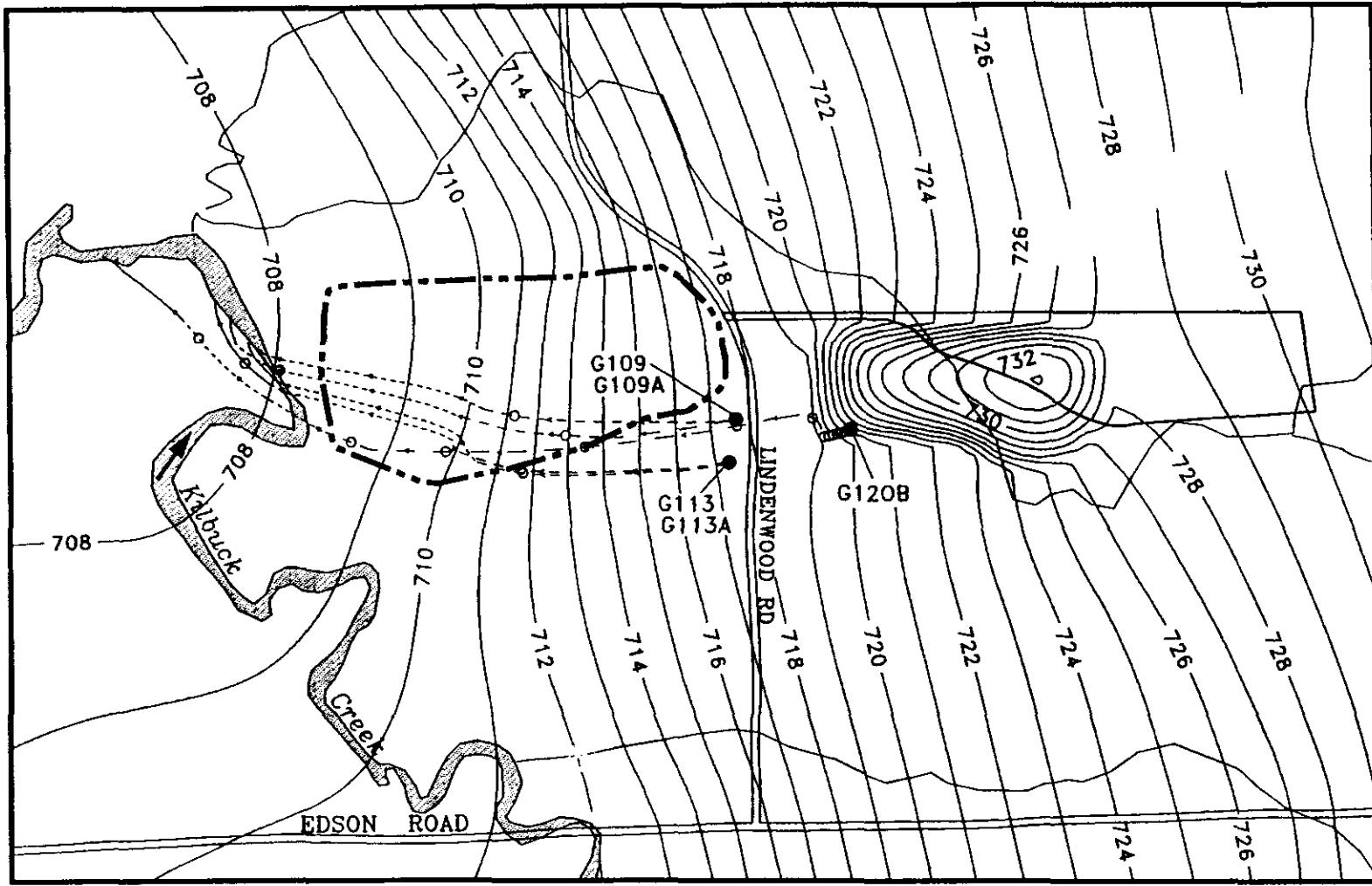






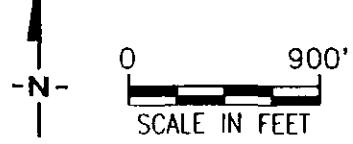


A detailed presentation of the particle tracking results is provided in GeoTrans (1995a). In this groundwater monitoring plan, particle tracking results are presented to examine the flow paths of groundwater particles placed at the location of the upgradient background monitoring wells (G109, G109A, G113, G113A, and G120B), which are screened in bedrock. Upgradient wells for this landfill must be screened in bedrock because only bedrock is saturated upgradient of the WRL site (the unconsolidated sediments pinch out below the landfill). The background monitoring wells were also chosen in order to monitor different zones of bedrock groundwater that flows upward into the sand and gravel aquifer. Figure 2.7 shows simulated bedrock water levels and forward particle traces for these particles. At these background monitoring well locations, it is apparent that groundwater particles flow upward into the unconsolidated portion of the aquifer system at the WRL site. In other words, these monitoring wells monitor upgradient groundwater that flows into the WRL site. The particle tracking results show that the location of the background monitoring wells is appropriate.



LEGEND

- 720.0— Water-Level Elevation (ft. msl) in Model Layer 3 (Upper Bedrock)
- Particle Trace in Layer 1
- Particle Trace in Layer 2
- Particle Trace in Layer 3
- Particle Trace in Layer 4
- Particle Trace in Layer 5
- Particle Location Every 3.0 Years



TITLE:

FORWARD PARTICLE TRACES FROM UPGRADE MONITORING WELLS.

LOCATION:

Winnebago Reclamation Services, Rockford, IL.

GeoTrans, inc.
GROUNDWATER SPECIALISTS

CHECKED:	D.B.
DRAFTED:	C.S.
FILE:	7735FM17
DATE:	6-29-95

FIGURE:
2-7

3 MONITORING WELL SYSTEMS

3.1 MONITORING WELL NETWORK

Because groundwater at the WRL site will be undergoing remediation, it is anticipated that up to three different monitoring programs may be required during the five-year life of the permit. These monitoring programs are:

- Operation and Maintenance (continued assessment monitoring)
- Verification
- Detection

The monitoring well networks for each of these programs are described below.

3.1.1 OPERATION AND MAINTENANCE MONITORING NETWORK

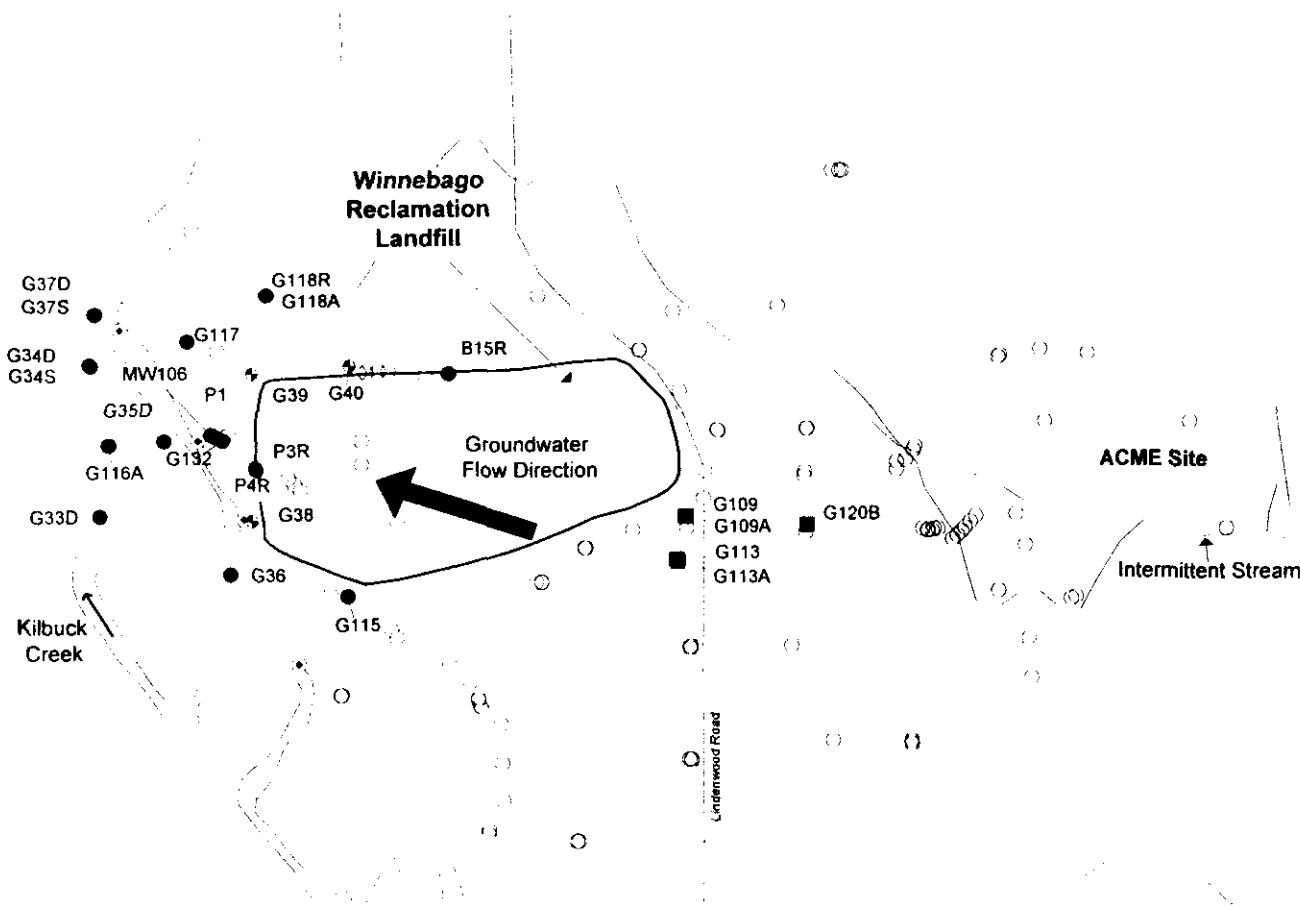
The proposed Operation and Maintenance (O&M) monitoring network will consist of 21 downgradient monitoring wells and 5 upgradient wells to monitor the cleanup of impacted groundwater. These monitoring wells are shown in Figure 3.1 and are listed below:

Existing downgradient O&M monitoring wells:

B15R	G37S/G37D	G118R/G118A
G33D	G115	MW106/P1/G132
G34S/G34D	G116A	P3R/P4R
G35D	G117	
G36		

Proposed new downgradient O&M monitoring wells:

- G38 (proposed 50 feet within the zone of attenuation)
- G39 (proposed at downgradient edge of zone of attenuation)
- G40 (proposed 50 feet within zone of attenuation)



Winnebago Reclamation Services

Legend

- O & M Monitoring Well
- Existing Monitoring Well
- ▲ Proposed Monitoring Well
- Background Monitoring Well
- ◎ Stream Gage

0 1000 2000
feet

TITLE:
**Operations and Maintenance (O&M)
Groundwater Monitoring Network**

LOCATION:
**Winnebago Reclamation Services,
Rockford, IL.**

CHECKED: AV
DRAFTED: PM
FILE: omgmn2.wor
DATE: 10-23-95

GeoTrans, Inc.

FIGURE:
3.1

Existing upgradient O&M monitoring wells:

- G109/G109A
- G113/G113A
- G120B

The O&M monitoring network wells monitor all potential constituent migration pathways in both the uppermost sand and gravel aquifer, and shallow bedrock below the uppermost aquifer. Table 3.1 provides well completion details for the existing O&M monitoring network wells. The proposed system of monitoring wells was used during previous studies to assess the quality and extent of impacted groundwater within the Groundwater Management Zone and will serve as an excellent assessment monitoring network during the O&M monitoring period. The upgradient background monitoring wells were determined based on observed groundwater flow directions and groundwater flow modeling. These monitoring wells will be sampled to evaluate background concentrations of leachate indicators and also to monitor any migration of VOCs from the Acme site.

3.1.2 VERIFICATION AND DETECTION MONITORING NETWORK

The proposed Verification and Detection Monitoring network consists of nine downgradient wells and five upgradient wells based on observed groundwater flow paths from the landfill source area. A total of six new monitoring wells (G38 through G42) are proposed based on the well spacing modeling described below in Section 3.1.2.1. The verification and detection monitoring wells are shown in Figure 3.2 and are listed below:

- P3R/P4R
- B15R

Proposed new verification and detection monitoring:

- | | | |
|-------|-------|-------|
| • G38 | • G40 | • G42 |
| • G39 | • G41 | • G43 |

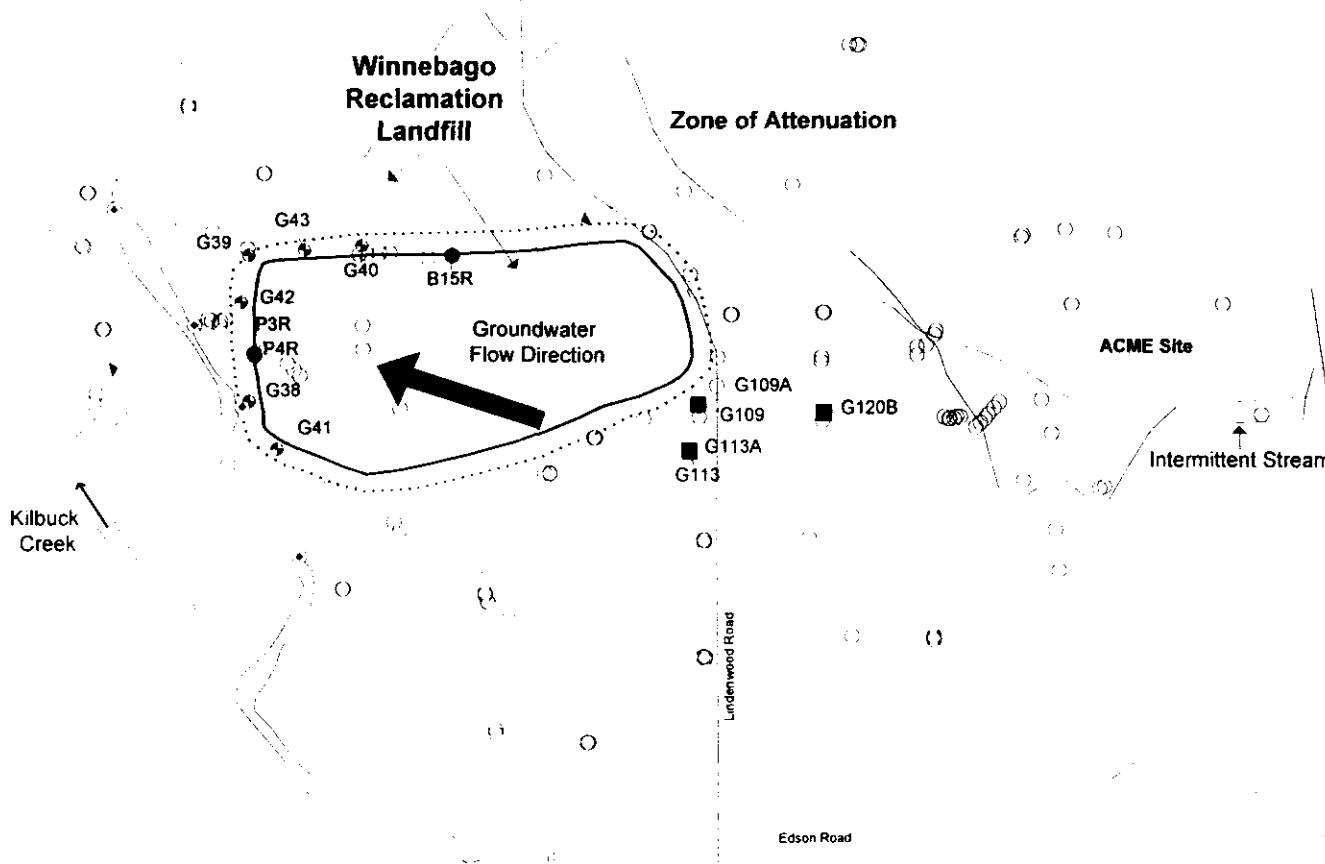
Existing upgradient wells:

- G109/G109A

Table 3.1. Screened intervals and hydrogeologic unit for the existing operation and maintenance monitoring network wells.

Well	Top of Screen	Bottom of Screen	Hydrogeologic Unit
B15R	703.79	698.79	Unconsolidated Sediments
G109	717.09	706.99	Bedrock
G109A	684.33	679.33	Bedrock
G113	725.00	711.40	Bedrock
G113A	697.00	685.00	Bedrock
G115	718.90	705.90	Unconsolidated Sediments
G116A	683.40	668.40	Unconsolidated Sediments
G132	631.70	626.70	Bedrock
G117	713.40	697.40	Unconsolidated Sediments
G118R	713.30	701.50	Unconsolidated Sediments
G118A	681.50	672.50	Unconsolidated Sediments
G120B	617.60	607.50	Bedrock
G33D	674.10	664.10	Unconsolidated Sediments
G34S	702.90	692.60	Unconsolidated Sediments
G34D	658.60	648.60	Unconsolidated Sediments
G35D	674.30	664.30	Unconsolidated Sediments
G36	683.30	673.30	Unconsolidated Sediments
G37S	698.50	693.50	Unconsolidated Sediments
G37D	637.30	627.30	Unconsolidated Sediments
MW106	674.39	664.39	Unconsolidated Sediments
P1	694.69	689.69	Unconsolidated Sediments
P3R	712.10	698.40	Unconsolidated Sediments
P4R	693.00	678.70	Unconsolidated Sediments

N



Winnebago Reclamation Services

Legend

- V & D Monitoring Well
- Existing Monitoring Well
- ✖ Proposed Monitoring Well
- Background Monitoring Well
- ◎ Stream Gage

0 1000 2000
feet

TITLE:
**Verification and Detection (V&D)
Groundwater Monitoring Network**

LOCATION:
**Winnebago Reclamation Services,
Rockford, IL.**

CHECKED: AV

DRAFTED: PM

FILE: vdgmn2.wor

DATE: 10-23-95

FIGURE:

3.2

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geotrans.com

- G113/G113A
- G120B

Table 3.2 provides well completion details for the existing verification and detection monitoring network wells.

3.1.2.1 WELL SPACING MODELING

The groundwater flow and solute transport code AT123D (Yeh, 1981) was used to determine an appropriate spacing for the Verification/Detection monitoring wells along the perimeter of the landfill. This code was also used in the GIA modeling (GeoTrans, 1995b), and was approved by IEPA during the May 30, 1995 presentation to IEPA. As discussed in detail in the GIA (GeoTrans, 1995b), the landfill liner was built to slope at a one to two percent grade toward the landfill invert LCM5. After leachate collection has lowered the leachate head to two feet at LCM5, the effective source area of saturated leachate will be reduced to an area radially around the invert. This source area, resulting from reduction of leachate head at LCM5 to two feet, was simulated during the GIA modeling. Therefore, any hypothetical release must also occur in this source area. For conservativeness, the hypothetical release was assumed to occur at the downgradient edge of this source area.

The Verification/Detection monitoring well network is designed to detect an IEPA-specified hypothetical release from the landfill at concentrations above the applicable groundwater standards at the edge of the zone of attenuation. The monitoring well spacing was determined based on the calculated plume width. A detailed discussion of the model parameter values is provided in the GIA. The model input parameter values and results are summarized below.

Conceptual Model

As in the GIA, shallow groundwater flow at the WRL site was represented as a homogeneous sand and gravel aquifer with uniform groundwater velocity. The aquifer

Table 3.2. Screened intervals and hydrogeologic unit for the existing verification and detection monitoring network wells.

Well	Top of Screen	Bottom of Screen	Hydrogeologic Unit
B15P	687.10	678.10	Bedrock
B15R	703.79	698.79	Unconsolidated Sediments
G109	717.09	706.99	Bedrock
G109A	684.33	679.33	Bedrock
G113	725.00	711.40	Bedrock
G113A	697.00	685.00	Bedrock
G120B	617.50	607.50	Bedrock
P3R	712.10	698.40	Unconsolidated Sediments
P4R	693.00	678.70	Unconsolidated Sediments

properties were determined based on observed sand and gravel aquifer data collected at the downgradient (northwest) edge of the landfill. The following assumptions have been made to perform the transport modeling:

- The aquifer flow parameters were assumed to be homogenous and isotropic. In other words, the aquifer hydraulic conductivity, effective porosity, thickness, and bulk density have uniform, constant values.
- The aquifer flow parameters were assumed to be homogenous and isotropic. In other words, the aquifer hydraulic conductivity, effective porosity, thickness, and bulk density have uniform, constant values.
- The dispersivity values were assumed to be constant throughout the aquifer but may vary with direction (i.e., longitudinal, transverse dispersivity).
- Groundwater flow is uniform in the positive X-direction.
- The mass release rate from the source is continuous.

Modeling Approach and Parameter Values

Site-specific data were used whenever available for the model parameter values. Reasonably conservative values were used when site-specific data were not available (i.e., dispersivity). The model was configured using field-determined parameter values and values calculated based on the source configuration. The same parameter values were used as those used in modeling for the GIA (except source mass release rate). A discussion of model parameter values and methods utilized for obtaining these values is presented below.

Source size – A one square meter source area was utilized for conducting the well spacing determination. The hypothetical release is located at the downgradient edge of the source area, which is centered around the landfill invert LCM5.

Dispersivity – Longitudinal dispersivity was estimated as one-tenth of the travel distance (Pickens and Grisak, 1981) from the source to the edge of the zone of attenuation. Using the distance from the source center (LCM5) to the edge of the zone of attenuation (1080 feet), the longitudinal dispersivity was estimated to be 108 feet (32.9m). It should be

noted that this distance (1080 ft) is based on the fact that the landfill source area will decrease once the leachate head is lowered to two feet. The value for lateral transverse dispersivity was then calculated as 20% of the longitudinal dispersivity, which is 21.6 feet (6.53m).

Porosity – A value of 0.30 for porosity of the sand and gravel aquifer was used. This value was obtained based on laboratory testing of soil sample collection during field investigations in March 1995.

Hydraulic Conductivity – The hydraulic conductivity for the sand and gravel aquifer was determined to be 1500 feet per day, which was obtained based on the pumping test performed at RW-01. Data and analysis of this pump test is presented in the Report of Hydrogeological Investigations (GeoTrans, 1995c). Given the high permeability of sand and gravel deposits, the value from a pumping test at a well near the zone of attenuation is much more reliable than values determined by slug testing.

Hydraulic Gradient – The hydraulic gradient was determined based on (GeoTrans, 1995b) potentiometric surface maps of the sand and gravel aquifer. An average horizontal gradient of 0.005 was estimated from the center of the source area to the downgradient edge of the zone of attenuation.

Mass Release Rate – The source mass release rate was adjusted to introduce a contaminant plume downgradient of the hypothetical source. Concentrations in the x-y plane were plotted such that a plume width could be determined (Appendix B, Figure B-1). The plume width is calculated 50 feet upgradient from the ZOA edge when any concentration isopleth (contour of constant concentration) intersects the outer edge of the ZOA (Appendix B, Figure B-1).

3.1.2.2 MODELING RESULTS

Modeling results indicate that the maximum width of the chloride plume is approximately 250 feet (76.3 m) at 50 feet within the zone of attenuation. A plot of the plume width (defined by a constant concentration contour) and model output are provided in Appendix A. It should be noted that, as stated in LCP-PA19, “The specific concentration used to define the plume is not consequential, as long as the plume width is defined by the

same concentration." Therefore, the 250 foot width of the contour in Appendix B at 50 feet within the zone of attenuation is the maximum allowable well spacing.

It should be noted that this plume width of 250 feet is a minimum estimate because the source area is very small (1 m^2). In other words, any releases will most likely occur through a larger source area and therefore produce a wider plume. Therefore, a recommended monitoring well of 250 feet (76.3 m) will provide a reasonable degree of confidence that the IEPA-hypothetical release from the landfill would be detected before the plume would reach the downgradient edge of the zone of attenuation, 100 feet (30.48 m). As stated previously, six new wells (G38, G39, G40, G41, G42, and G43) are proposed to complete the perimeter monitoring system based on this well spacing simulation.

3.2 WELL CONSTRUCTION

The well construction details of proposed D&M and verification wells are summarized below. Well nest MW106/P1 was installed by E.C. Jordan in 1984, and both were constructed with two-inch inside diameter (ID) polyvinyl chloride (PVC) riser and screen. Well G104 was installed by Testing Engineers, Inc. in 1972 and is constructed of two-inch ID PVC. Wells P3R, P4R, B15R, G109, G109A, G113, G113A, G115, G116, G116A, G117, G118A, and G119A were installed by Warzyn in 1987, and well G118R in 1988, and each was constructed of two-inch ID galvanized riser pipe, and stainless steel screens. Well G120B was installed by Warzyn in 1991 and was constructed of two-inch ID stainless steel riser pipe and stainless steel screen. Well R119 was installed by WRL in 1993 and was constructed of two-inch ID stainless steel riser pipe and stainless steel screen. In February 1994, monitoring wells G130, G130A, G131, G131A were also constructed of two-inch ID stainless steel risen pipe and screen. Monitoring wells G116D and G132 were installed in August 1994 according to construction specifications as stated in 35 IAC 811.318d. Monitoring wells G33S, G33D, G34S, G34D, G35S, G35D, G36, G37S, and G37D were also installed according to 35 IAC 811.318d by WRL in 1995. The boring logs and well construction diagrams for these existing wells are provided in Appendix A.

New wells will be constructed of two-inch ID (minimum) stainless steel #316 riser pipe and stainless #316 steel screen (0.01-inch openings). The well screen will be ten feet long when intersecting the water table and five feet long when placed below the water table. The annular space around the screen will consist of clean silica or flint sand to two feet above the top of the screen. A two-foot (minimum) bentonite seal will be placed above the sand pack. The remainder of the annular space will be backfilled with a bentonite slurry or a cement/ bentonite slurry. A lockable protective steel casing will be set in concrete over the well at the ground surface. The drilling methods may include 4.25-inch (minimum) ID hollow-stem augers, with water or mud rotary. Wells will be constructed following 77 IAC 920 Illinois Water Well Construction Code. The appropriate well construction reports will be prepared and submitted to the IEPA and IDPH.

3.3 WELL DEVELOPMENT

After a minimum of 24 hours has elapsed since completion of well construction, each new well will be developed using a bailer, surge block, or pump. A minimum of ten well volumes will be removed during development. After the completion of well development, a slug or baildown test will be performed at each new well to determine the hydraulic conductivity.

3.4 WELL PLUGGING AND ABANDONMENT

Borings that are not completed as wells, and monitoring wells and water supply wells to be decommissioned, will be abandoned in the same manner as previous investigative borings and monitoring wells. Specifically, following 77 IAC 920, Illinois Water Well Construction Code and Table 1 of the IEPA's "Groundwater Monitoring Network for Non-Hazardous Solid Waste Disposal Facilities," April 1990, Final Draft. Open drill holes will be marked until properly abandoned. The special regulatory requirements for abandonment of borings and wells based upon the geologic materials present will be followed.

4 MONITORING PROGRAMS

The following section provides a description of proposed monitoring programs to be conducted during landfill operation, and during the post-closure care period. Since a release from the landfill to groundwater has already been confirmed, and a remedial design is in preparation, the proposed program will consist of:

- O&M monitoring – An assessment monitoring program to be conducted until near completion of aquifer remediation activities.
- Verification monitoring – to be conducted following O&M monitoring during the last stages of active aquifer remediation activities.
- Detection monitoring – to be conducted following completion of aquifer remediation activities.

It is anticipated that, from the perspective of groundwater monitoring, the groundwater remediation planned for the WRL site will generally conform to the following sequence of activities:

- A. Install remedial system and establish initial levels and distribution of contamination.
- B. Start up remedial system and continue operation.
- C. Monitor for proper system adjustment.
- D. Continue to remediate and monitor mass reduction of dissolved contamination and progression toward attainment of cleanup standards.

- E. Terminate remedial activities when cleanup standards are attained or when continued system operation yields no appreciable decrease in contaminant levels.
- F. Allow groundwater levels and concentrations to re-equilibrate to pre-remedial conditions and conduct verification monitoring to determine compliance with cleanup standards.
- G. If cleanup standards are not attained, make necessary adjustments to the remedial system and resume operation. (Note: Typically, two to three cycles of remedial system termination, verification monitoring, and system resumption may be required prior to final termination of remedial system.)
- H. Conduct final verification monitoring and implement termination and closure of remediation system. Begin detection monitoring in accordance with the requirements of 35 IAC 811.319(a).

It is currently anticipated that the remedial system for the WRL site will be operational in the third quarter of 1996. It is expected that the system will remain operational for a minimum of five to seven years before final termination. At least one solid waste permit renewal period may elapse during active remediation of groundwater at the WRL site. A summary of the proposed monitoring programs is provided in Table 4.1.

4.1 ESTABLISHMENT OF BACKGROUND CONCENTRATIONS

In accordance with 35 IAC sections 811.320(d) and 811.320(e)(1) through (6), 4 quarters of data for determining the Applicable Groundwater Quality Standards (AGQS) for those parameters presented in Attachment 1 to Appendix C in IEPA LPC-PA2 have been determined for the existing facility. Leachate samples were then collected from the existing facility to establish a current baseline list of detectable leachate constituents and concentrations in order to perform the GIA transport modeling. This list of detectable leachate constituents is also used to provide a basis for determining an appropriate list of compounds for routine monitoring. Although the comprehensive list used to determine the AGQS's includes parameters that have not been detected within the leachate, it provides a baseline statistical limit against which the current or future impacts of this facility to existing

Table 4.1. Summary of groundwater monitoring programs.

Monitoring Program	Objectives	Period of Implementation	Sampling Parameters	Sampling Frequency and Duration	Criteria for Termination
Operation and Maintenance (O&M)	Assessment of groundwater impacts and remedial activities	During operation of groundwater remediation system	Inorganic and organic indicators Table 4.4	Quarterly Semi-annual for detectable leachate constituents	Cleanup goals are approached
Verification	Verify cleanup of leachate constituent concentrations	Immediately prior to cessation of active groundwater extraction	Table 4.4	Quarterly (2 years) Annually	Appropriate provisions of IAC are met ¹
Detection	Detection of significant increases in leachate constituent concentrations which may indicate a release from the landfill	After completion of groundwater remediation and leachate head reduction	Inorganic Indicators Table 4.4	Quarterly ² Annually	N/A

¹ 35IAC811.319(d)(5)(A)

² Frequency may be adjusted to annually provided appropriate subsections of 35IAC811.319 are achieved.

groundwater quality may be measured. Determination of background concentrations and the statistical methods (Appendix B) used to develop this background data are important component of the overall assessment of the potential impacts this facility may have upon groundwater resources in the vicinity of the site.

4.1.1 DETERMINATION OF LEACHATE CONSTITUENTS

In order to characterize the WRL leachate, leachate samples have been collected both spatially and temporally throughout the landfill. The leachate chemical data is provided in Appendix C of the GIA Report (GeoTrans, 1995b). On April 27, 1992, leachate samples were collected from 19 gas withdrawal wells (20 samples) at the existing landfill. The 20 samples were composited into four groups for laboratory analysis based on a representative spatial distribution across the site. The active gas collection system was shut off prior to sampling in order to avoid stripping any organic compounds from the leachate. An additional round of leachate sampling was recently performed in April 1995. In this sampling event, leachate samples were collected from four gas extraction wells (N1, E3, G7, and west manhole) across the site. Based on the results of these leachate sampling events, a baseline list of leachate constituents was compiled.

4.1.2 EXISTING BACKGROUND GROUNDWATER QUALITY

The background monitoring program consists of two nested well groups and a single deep well for a total of five upgradient wells (G109/G109A, G113/G113A, and G120B). Background concentrations in the groundwater were determined based on observed constituent concentrations at upgradient monitoring wells. Analytical results of the four quarters of data (August 93, November 1993, February 1994, and May 1994) collected from the background wells is presented in Table 4.2. The analytical results from the laboratory are provided in Appendix C.

Since the uppermost aquifer upgradient of the existing facility is present only within the dolomite bedrock, all of the background wells are screened at various depths within the

Table 4.2. Summary of background groundwater concentrations.

Compound	Well Number and Date of Sampling																			
	G109				G109A				G113				G113A				G120B			
	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94
2,4-D,2,4-dichlorophenoxy-acetic acid	1.00	0.25		0.25	1.00	0.25		0.13	1.00	0.25		0.25	1.00	0.25		0.25	1.00	0.13		0.25
Acetone;2-Propane	2.50	5.00	5.00	5.00	2.50	5.00	5.00	5.00	2.50	5.00	5.00	5.00	2.50	5.00	5.00	5.00	2.50	5.00	5.00	5.00
Acrolein	50.00	12.50	12.50	12.50	50.00	12.50	12.50	12.50	50.00	12.50	12.50	12.50	50.00	12.50	12.50	12.50	50.00	12.50	12.50	12.50
Acrylonitrile	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Aalachor*	1.00	0.50	0.50	0.50	1.00	0.50	0.50	0.50	1.00	0.50	0.50	0.50	1.00	0.50	0.50	0.50	1.00	0.50	0.50	0.50
Aldicarb	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Aldrin	0.03	0.03	0.03	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.25	0.03	0.03	0.06	0.03	0.03	0.03	0.03
Alkalinity (total)	676.00	652.00	703.00		548.00	605.00	638.00	623.00	604.00	625.00	245.00	438.00	680.00	686.00	771.00	815.00	270.00	264.00	263.00	253.00
Aluminum	990.00	200.00	1300.00	560.00	790.00	630.00	600.00	8090.00	1000.00	12200.00	44000.00	28800.00	1000.00	12500.00	440.00	420.00	410.00	700.00	870.00	150.00
Aluminum (dis)	1110.00	25.00	25.00	25.00	1060.00	60.00	25.00	25.00	1210.00	50.00	25.00	1140.00	25.00	25.00	25.00	380.00	25.00	25.00	25.00	25.00
Ammonia	500.00	50.00		130.00	500.00	170.00			110.00	900.00	140.00			50.00	200.00	50.00	50.00	500.00	50.00	50.00
Antimony	250.00	2.50	2.50	2.50	250.00	2.50	2.50	250.00	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Antimony (dis)	250.00	2.50	2.50	2.50	250.00	2.50	2.50	250.00	2.50	2.50	8.00	17.00	250.00	2.50	2.50	2.50	250.00	2.50	2.50	5.00
Arsenic	1.00	1.00	1.00	1.00	1.00	1.00	1.00	7.00	1.00	5.00	1.00	10.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Arsenic (dis)	0.50	1.00	1.00	1.00	0.50	1.00	1.00	1.00	1.00	0.50	1.00	1.00	0.50	1.00	1.00	1.00	0.50	1.00	1.00	1.00
Atrazine	1.50	0.25	0.25	0.25	1.50	0.25	0.25	0.25	1.50	0.25	0.25	1.50	0.25	0.25	0.25	0.25	1.50	0.25	0.25	0.25
Barium	100.00	140.00	170.00	140.00	100.00	140.00	150.00	200.00	100.00	220.00	540.00	500.00	100.00	150.00	140.00	160.00	100.00	110.00	100.00	90.00
Barium (dis)	100.00	140.00	130.00	140.00	100.00	140.00	140.00	140.00	100.00	100.00	50.00	100.00	100.00	140.00	140.00	140.00	100.00	80.00	80.00	80.00
Benzene*	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	2.80	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Benzoic Acid	5.00	250.00	26.00	25.00	5.00	25.00	26.00	25.50	5.00	26.50	25.50	26.00	5.00	25.00	25.00	25.00	5.00	25.00	26.50	25.00
Beryllium	2.50	0.10	0.10	0.10	2.50	0.10	0.10	2.00	2.50	1.00	0.10	5.00	2.50	0.10	0.10	0.10	2.50	0.10	0.10	0.10
Beryllium (dis)	2.50	0.10	0.10	0.10	2.50	0.10	0.10	0.10	2.50	0.10	0.10	0.10	2.50	0.10	0.10	0.10	2.50	0.10	0.10	0.10
Biological Oxygen Demand (BOD)	1.00	0.50	2.00	0.50	1.00	3.00	2.00	2.00	1.00	0.50	4.00	0.50	1.00	3.00	2.00	0.50	1.00	0.50	0.50	0.50
bis (2-Chloroethoxy) methane	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
bis (2-Ethylhexyl) phthalate	24.00	20.00	29.00	2.00	5.00	2.00	72.00	2.00	5.00	2.10	31.00	2.00	5.00	2.00	63.00	2.00	5.00	2.00	41.00	2.00
Boron	25.00	50.00	50.00	50.00	25.00	50.00	50.00	25.00	50.00	200.00	140.00	52.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Boron (dis)	25.00	50.00	50.00	50.00	25.00	50.00	50.00	98.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	
Bromobenzene, Phenyl bromide	0.50	2.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	2.50
Bromochloromethane	0.50	2.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	2.50
Bromodichloromethane	0.50	2.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	2.50
Bromoform; Tribromomethane	0.50	2.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	2.50
Bromomethane, Methyl bromide	0.50	5.00	5.00	5.00	0.50	5.00	5.00	0.50	5.00	5.00	0.50	5.00	5.00	0.50	5.00	5.00	0.50	5.00	5.00	5.00
Butanol 1,2,sec-butyl alcohol	2.50	50.00	50.00	50.00	2.50	50.00	50.00	50.00	2.50	50.00	50.00	50.00	2.50	130.00	50.00	50.00	2.50	50.00	50.00	50.00
Butanol 1,n-butyl alcohol	2.50	50.00	50.00	50.00	2.50	50.00	50.00	2.50	50.00	50.00	50.00	2.50	160.00	50.00	50.00	2.50	50.00	50.00	50.00	
Butanone, 2-, Methyl ethyl ketone	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Butylbenzene, n-, 1-Phenylbutane	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50
Butylbenzene, sec- (1-Methylpropyl)benzene	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50
Butylbenzene, tert- (1,1-Dimethylethyl)benzene	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50
Butylbenzyl phthalate	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Cadmium	5.00	2.50	45.00	0.40	5.00	2.50	2.50	26.00	5.00	2.50	29.00	0.40	5.00	2.50	2.50	1.30	5.00	2.50	2.50	0.40

Table 4.2. Summary of background groundwater concentrations (continued).

Compound	Well Number and Date of Sampling																			
	G109				G109A				G113				G113A				G120B			
	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94
Cadmium (dis)	5.00	0.50	2.50	0.30	5.00	0.10	2.50	0.10	5.00	0.10	2.50	0.10	5.00	0.60	2.50	0.10	5.00	0.10	2.50	0.10
Calcium	198000.00	190000.00	222000.00	219000.00	152000.00	162000.00	178000.00	211000.00	394000.00	419000.00	3180000.00	2600000.00	197000.00	176000.00	196000.00	216000.00	71000.00	76000.00	70000.00	68800.00
Calcium (dis)	188000.00	196000.00	201000.00	198000.00	149000.00	168000.00	181000.00	180000.00	152000.00	165000.00	83700.00	153000.00	194000.00	161000.00	193000.00	200000.00	70000.00	67300.00	67400.00	66300.00
Carbofuran	0.50	0.50	0.50	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Carbon disulfide	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Carbon tetrachloride	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Chemical Oxygen Demand (COD)	15.50	50.00	21.00	10.00	10.00	42.00	25.00	22.00	10.00	46.00	10.00	10.00	46.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Chlordane*	0.25	0.25	0.26	0.50	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.60	0.25	0.25	0.25
Chloride	12000.00	34000.00		25000.00	36000.00	30000.00		34000.00	36000.00	38000.00		34000.00	28000.00	25000.00		48000.00	14000.00	12000.00		13000.00
Chlorobenzene, Monochlorobenzene	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Chlorodibromomethane	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Chloroethane, ethyl chloride	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Chloroethyl Vinyl Ether, 2-	1.00	5.00	5.00	5.00	1.00	5.00	5.00	5.00	1.00	5.00	5.00	5.00	1.00	5.00	5.00	5.00	1.00	5.00	5.00	5.00
Chloroform	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Chloronaphthalene, 2-	5.00	50.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Chlorotoluene, o-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Chlorotoluene, p-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Chromium	10.00	20.00	330.00	90.00	10.00	40.00	60.00	210.00	10.00	60.00	180.00	110.00	10.50	60.00	300.00	20.00	10.00	190.00	5.00	5.00
Chromium (dis)	10.00	0.10	5.00	5.00	10.00	0.10	5.00	5.00	10.00	0.10	5.00	5.00	10.00	0.10	100.00	5.00	10.00	1.10	5.00	5.00
Cobalt	50.00	5.00	5.00	5.00	50.00	5.00	5.00	5.00	50.00	10.00	40.00	30.00	50.00	5.00	5.00	50.00	5.00	50.00	5.00	50.00
Cobalt (dis)	50.00	5.00	5.00	5.00	50.00	5.00	5.00	5.00	50.00	5.00	5.00	5.00	50.00	5.00	5.00	50.00	5.00	50.00	5.00	50.00
Copper	10.00	10.00	80.00	20.00	10.00	5.00	5.00	30.00	11.50	50.00	220.00	170.00	10.00	20.00	10.00	10.00	10.00	10.00	10.00	5.00
Copper (dis)	10.00	5.00	5.00	5.00	10.00	5.00	5.00	5.00	10.00	5.00	5.00	5.00	10.00	5.00	5.00	5.00	10.00	5.00	5.00	5.00
Cresol, p-, cresol, 4-methylphenol	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Cumene	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50
Cyanide (Total as Cr-)	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	19.00	34.00	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Cymene, p-Isopropyltoluene.																				
Dicyclomene	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50
DBCP	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
DDD		0.05	0.05	0.10		0.05	0.05	0.05		0.05	0.05	0.05		0.05	0.05	0.05	0.05	0.13	0.05	0.05
DDE		0.05	0.05	0.10		0.05	0.05	0.05		0.05	0.05	0.05		0.05	0.05	0.05	0.05	0.13	0.05	0.05
DDT		0.05	0.05	0.05	0.10	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.13	0.05	0.05
Di-n-butyl phthalate	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Dichloro-2-butene, trans-1,4-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Dichlorobenzene, 1,2-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Dichlorobenzene, 1,3-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Dichlorobenzene, 1,4-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Dichlorodifluoromethane	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Dichloroethane, 1,1-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Dichloroethane, 1,2-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50

Geotans, inc.

Summary of background groundwater concentrations (continued).

	Well Number and Date of Sampling																				
	G109				G109A				G113				G113A				G120B				
	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	
	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	2.10	2.50	2.50	2.50	
	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	115.00	2.50	2.50	0.50	59.00	2.50	2.50	
	0.50	2.50	2.50	2.50	3.90	2.50	5.00	2.50	0.50	2.50	2.50	2.50	130.00	115.00	110.00	150.00	68.00	59.00	46.00	43.00	
	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	2.50	2.50	
	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	4.80	6.00	2.50	2.50	0.50	2.50	2.50	2.50	
	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	2.50	2.50	
	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	2.50	2.50	
	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	2.50	2.50	
	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	2.50	2.50	
	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	2.50	2.50	
	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	2.50	2.50	
	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	2.50	2.50	
	0.05	0.05	0.05	0.10	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.13	0.05	0.05	0.05	
	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	
		2.50	2.50	2.50		2.50	2.50		2.50	2.50	2.50		2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	
	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	
	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	
	0.03	0.03	0.05		0.03	0.03	0.25		0.03	0.03	0.03		0.03	0.03	0.03	0.03	0.06	0.03	0.03	0.03	
	0.05	0.05	0.10		0.05	0.05	0.05		0.05	0.05	0.05		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
	0.05	0.05	0.10	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.13	0.05	0.05	0.05	
	0.05	0.05	0.10	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.13	0.05	0.05	0.05	
	0.05	0.05	0.10	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.13	0.05	0.05	0.05	
	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	
	2.50	50.00	50.00	50.00	2.50	50.00	50.00	50.00	2.50	50.00	50.00	50.00	2.50	50.00	50.00	50.00	2.50	50.00	50.00	50.00	
	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	
	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	
	130.00	50.00	50.00	130.00	120.00	50.00	50.00	100.00	140.00	50.00	50.00	200.00	110.00	50.00	50.00	110.00	110.00	50.00	50.00	100.00	
	0.03	0.03	0.03	0.05	0.03	0.03	0.25	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.06	0.03	0.03	0.03	
	0.03	0.03	0.03	0.05	0.03	0.03	0.25	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.06	0.03	0.03	0.03	
	0.03	0.03	0.03	0.05	0.03	0.03	0.25	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.06	0.03	0.03	0.03	
	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	
	0.50	5.00	5.00	5.00	0.50	5.00	5.00	5.00	0.50	5.00	5.00	5.00	0.50	5.00	5.00	5.00	0.50	5.00	5.00	5.00	
	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	
	25.00	10.00	10.00	10.00	115.00	330.00	4530.00	4160.00	25.00	10.00	10.00	25.00	10.00	90.00	80.00	45.00	150.00	320.00	90.00		
	920.00	1230.00	1910.00	4250.00	2900.00	6560.00	8700.00	56000.00	1500.00	16850.00	147000.00	86300.00	150.00	2550.00	3320.00	1500.00	260.00	2560.00	2080.00	470.00	
	5.00	50.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	
	2.50	28.00	956.00	119.00	2.50	30.00	54.00	210.00	4.35	49.00	1.50	174.00	2.50	17.00	20.00	1.50	2.50	8.00	4.00	3.00	
	2.50	1.50	4.00	1.50	2.50	1.50	3.00	1.50	2.50	1.50	1.50	1.50	2.50	1.50	1.50	3.50	1.50	1.50	1.50	1.50	
	67000.00	58900.00	76600.00	73600.00	51000.00	52100.00	59800.00	71300.00	188000.00	411000.00	1790000.00	1350000.00	76000.00	75900.00	82400.00	96700.00	38000.00	37800.00	36700.00	37200.00	

Table 4.2. Summary of background groundwater concentrations (continued).

Compound	Well Number and Date of Sampling																			
	G109				G109A				G113				G113A				G120B			
	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94
Cadmium (dis)	5.00	0.50	2.50	0.30	5.00	0.10	2.50	0.10	5.00	0.10	2.50	0.10	5.00	0.60	2.50	0.10	5.00	0.10	2.50	0.10
Calcium	198000.00	190000.00	222000.00	219000.00	152000.00	162000.00	178000.00	211000.00	394000.00	419000.00	3180000.00	2600000.00	197000.00	176000.00	196000.00	216000.00	71000.00	76000.00	70000.00	68800.00
Calcium (dis)	188000.00	196000.00	201000.00	198000.00	149000.00	168000.00	181000.00	180000.00	152000.00	165000.00	83700.00	153000.00	194000.00	181000.00	193000.00	200000.00	70000.00	67300.00	67400.00	66300.00
Carbofuran	0.50	0.50	0.50	5.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Carbon disulfide	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Carbon tetrachloride	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Chemical Oxygen Demand (COD)	15.50	50.00	21.00	10.00	10.00	42.00	25.00	22.00	10.00	46.00	10.00	10.00	10.00	46.00	10.00	10.00	10.00	10.00	10.00	10.00
Chlordane*	0.25	0.25	0.26	0.50	0.25	0.25	0.26	0.25	0.25	0.25	0.26	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Chloride	12000.00	34000.00		25000.00	36000.00	30000.00		34000.00	35000.00	38000.00		34000.00	28000.00	25000.00		48000.00	14000.00	12000.00		13000.00
Chlorobenzene, Monochlorobenzene	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Chlorodibromomethane	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Chloroethane, ethyl chloride	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Chloroethyl Vinyl Ether, 2-	1.00	5.00	5.00	5.00	1.00	5.00	5.00	5.00	1.00	5.00	5.00	5.00	1.00	5.00	5.00	5.00	1.00	5.00	5.00	5.00
Chloroform	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Chloronaphthalene, 2-	5.00	50.00	50.00	5.00	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Chlorotoluene, o-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Chlorotoluene, p-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Chromium	10.00	20.00	33.00	9.00	10.00	40.00	60.00	210.00	10.00	60.00	180.00	110.00	10.50	60.00	300.00	20.00	10.00	190.00	5.00	5.00
Chromium (dis)	10.00	0.10	5.00	5.00	10.00	0.10	5.00	5.00	10.00	0.10	5.00	5.00	10.00	0.10	100.00	5.00	10.00	1.10	5.00	5.00
Cobalt	50.00	5.00	5.00	5.00	50.00	5.00	5.00	5.00	50.00	10.00	40.00	30.00	50.00	5.00	5.00	5.00	50.00	5.00	5.00	5.00
Cobalt (dis)	50.00	5.00	5.00	5.00	50.00	5.00	5.00	5.00	50.00	5.00	5.00	5.00	50.00	5.00	5.00	5.00	50.00	5.00	5.00	5.00
Copper	10.00	10.00	80.00	20.00	10.00	5.00	5.00	30.00	11.50	50.00	220.00	170.00	10.00	20.00	10.00	10.00	10.00	10.00	5.00	5.00
Copper (dis)	10.00	5.00	5.00	5.00	10.00	5.00	5.00	5.00	10.00	5.00	5.00	5.00	10.00	5.00	5.00	5.00	10.00	5.00	5.00	5.00
Cresol, p-, cresol, 4-methylphenol	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00
Cumene	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50
Cyanide (Total as Cn-)	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Cymene, p-isopropyltoluene, Dolcymene	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50
DBCP	0.50	2.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	2.50
DDD		0.05	0.05	0.10		0.05	0.05	0.05		0.05	0.05	0.05		0.05	0.05	0.13		0.05	0.05	0.05
DDE		0.05	0.05	0.10		0.05	0.05	0.05		0.05	0.05	0.05		0.05	0.05	0.13		0.05	0.05	0.05
DDT	0.05	0.05	0.05	0.10	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.13	0.05	0.05	0.05	0.05
Di-n-butyl phthalate	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00
Dichloro-2-butene, trans-1,4-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Dichlorobenzene, 1,2-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	2.50
Dichlorobenzene, 1,3-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	2.50
Dichlorobenzene, 1,4-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	2.50
Dichlorodifluoromethane	0.50	2.50	2.50	2.50	0.50	2.60	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	10.00	19.00	2.50	2.50	0.50
Dichloroethane, 1,1-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	31.00	29.00	24.00	29.00	11.00
Dichloroethane, 1,2-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	2.50

Table 4.2. Summary of background groundwater concentrations (continued).

Compound	Well Number and Date of Sampling																			
	G109				G109A				G113				G113A				G120B			
	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94
Dichloroethylene, 1,1-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	2.10	2.50	2.50	2.50
Dichloroethylene, 1,2-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	115.00	2.50	2.50	0.50	59.00	2.50	2.50
Dichloroethylene, cis-1,2-	0.50	2.50	2.50	2.50	3.90	2.50	5.00	2.50	0.50	2.50	2.50	2.50	130.00	115.00	110.00	150.00	68.00	59.00	46.00	43.00
Dichloroethylene, trans-1,2-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Dichloropropane, 1,2-*	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	4.80	6.00	2.50	2.50	0.50	2.50	2.50	2.50
Dichloropropane, 1,3-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Dichloropropane, 2,2-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Dichloropropene, 1,1-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Dichloropropene, 1,3-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Dichloropropene, cis-1,3-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Dichloropropene, trans-1,3-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Dieldrin	0.05	0.05	0.05	0.10	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.13	0.05	0.05	0.05
Diethyl phthalate	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00
Difluorobenzene, 1,4-		2.50	2.50	2.50		2.50	2.50	2.50		2.50	2.50	2.50		2.50	2.50	2.50		2.50	2.50	2.50
Dimethyl phthalate	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00
Dimethylphenol, 2,4-	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00
EDB	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Endosulfan I	0.03	0.03	0.05		0.03	0.03	0.25		0.03	0.03	0.03			0.03	0.03	0.06		0.03	0.03	0.03
Endosulfan II	0.05	0.05	0.10		0.05	0.05	0.05		0.05	0.05	0.05			0.05	0.05	0.13		0.05	0.05	0.05
Endosulfan Sulfate	0.05	0.05	0.10		0.05	0.05	0.05		0.05	0.05	0.05			0.05	0.05	0.13		0.05	0.05	0.05
Endrin	0.05	0.05	0.05	0.10	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.13	0.05	0.05	0.05
Endrin Aldehyde	0.05	0.05	0.10		0.05	0.05	0.05		0.05	0.05	0.05			0.05	0.05	0.13		0.05	0.05	0.05
Endrin Ketone	0.05	0.05	0.10		0.05	0.05	0.05		0.05	0.05	0.05			0.05	0.05	0.13		0.05	0.05	0.05
Ethyl acetate	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Ethyl Alcohol	2.50	50.00	50.00	50.00	2.50	50.00	50.00	50.00	2.50	50.00	50.00	50.00	2.50	50.00	50.00	50.00	2.50	50.00	50.00	50.00
Ethyl Methacrylate	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Ethylbenzene	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Fluoride (Total as F-)	130.00	50.00	50.00	130.00	120.00	50.00	100.00	140.00	50.00	50.00	200.00	110.00	50.00	50.00	110.00	110.00	50.00	50.00	100.00	
gamma-BHC	0.03	0.03	0.03	0.05	0.03	0.03	0.25	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.06	0.03	0.03	0.03	0.03
Heptachlor Epoxide*	0.03	0.03	0.03	0.05	0.03	0.03	0.25	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.06	0.03	0.03	0.03	0.03
Heptachlor*	0.03	0.03	0.03	0.05	0.03	0.03	0.25	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.06	0.03	0.03	0.03	0.03
Hexachlorobutadiene	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00
Hexanone, 2-	0.50	5.00	5.00	5.00	0.50	5.00	5.00	5.00	0.50	5.00	2.50	2.50	0.50	5.00	5.00	5.00	0.50	5.00	5.00	5.00
Iodomethane	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	5.00	5.00	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Iron (dis)	25.00	10.00	10.00	10.00	115.00	3300.00	4530.00	4160.00	25.00	10.00	10.00	10.00	25.00	10.00	90.00	80.00	45.00	150.00	320.00	90.00
Iron (Total)	920.00	1230.00	1910.00	4250.00	2900.00	6560.00	8700.00	56000.00	1500.00	16850.00	147000.00	86300.00	150.00	2550.00	3320.00	1500.00	260.00	2560.00	2080.00	470.00
Isophorone	5.00	50.00	50.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Lead	2.50	28.00	956.00	119.00	2.50	30.00	54.00	210.00	4.35	49.00	1.50	174.00	2.50	17.00	20.00	1.50	2.50	8.00	4.00	3.00
Lead (dis)	2.50	1.50	4.00	1.50	2.50	1.50	3.00	1.50	2.50	1.50	1.50	1.50	2.50	1.50	1.50	3.50	1.50	1.50	1.50	1.50
Magnesium	67000.00	58900.00	76600.00	73600.00	51000.00	52100.00	59800.00	71300.00	118800.00	411000.00	1790000.00	1350000.00	76000.00	75900.00	82400.00	96700.00	38000.00	37800.00	36700.00	37200.00

Table 4.2. Summary of background groundwater concentrations (continued).

Compound	Well Number and Date of Sampling																			
	G109				G109A				G113				G113A				G120B			
	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94
Magnesium (dis)	57000.00	58400.00		63300.00	49000.00	54300.00		59400.00	67000.00	67800.00		66100.00	74000.00	76900.00		86600.00	37000.00	36300.00		37800.00
Manganese	34.00	50.00	180.00	90.00	185.00	230.00	280.00	780.00	765.00	1470.00	6720.00	4870.00	280.00	250.00	220.00	240.00	22.00	70.00	100.00	50.00
Manganese (dis)	37.00	40.00	60.00	40.00	67.00	230.00	240.00	260.00	80.00	70.00	5.00	40.00	281.00	220.00	190.00	180.00	20.00	20.00	30.00	5.00
Mercury	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.40	0.20	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Mercury (dis)	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Methoxychlor	0.25	0.25	0.26	0.50	0.25	0.25	0.26	0.25	0.25	0.25	0.05	0.05	0.25	0.25	0.25	0.60	0.25	0.25	0.27	0.25
Methyl chloride	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Methyl-2-pentanone, 4-	2.50	5.00	5.00	5.00	2.50	5.00	5.00	5.00	2.50	5.00	5.00	5.00	2.50	5.00	5.00	5.00	2.50	5.00	5.00	5.00
Methylene bromide	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Methylene chloride	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Naphthalene	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00
Nickel	20.00	10.00	160.00	60.00	20.00	20.00	40.00	120.00	20.00	40.00	60.00	20.00	40.00	160.00	20.00	20.00	90.00	10.00	30.00	
Nickel (dis)	20.00	10.00	10.00	10.00	20.00	10.00	10.00	10.00	20.00	10.00	10.00	10.00	20.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Nitrate (as Nitrogen)	2320.00	2840.00	2840.00	3030.00	1030.00	410.00	1950.00	1170.00	5410.00	3360.00	5640.00	5660.00	3070.00	2580.00	2980.00	2660.00	1780.00	2320.00	2590.00	2390.00
Nitrobenzene	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00
Nitrophenol, 4-; p-Nitrophenol	5.00	250.00	26.00	25.00	5.00	25.00	26.00	25.50	5.00	26.50	25.50	26.00	5.00	25.00	25.00	25.00	5.00	25.00	26.50	25.00
Oil (Hexane soluble or equiv)	2.50	0.50	2.00	0.50	2.50	0.50	0.50	1930.00	2.50	0.50	0.50	1.00	2.50	0.50	0.50	0.50	2.50	1.00	2.00	1.00
Parathion, 0,0-Diethyl phosphorothioic acid	0.50	0.25	0.25	0.25	0.50	0.25	0.25	0.25	0.50	0.25	0.25	0.25	0.50	0.25	0.25	0.25	0.50	0.25	0.25	0.25
PCBs, Polychlorinated biphenyls*	0.50	0.50	0.50	1.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	1.25	0.50	0.50	0.50
Pentachlorophenol*	5.00	250.00	26.00	25.00	5.00	25.00	26.00	25.50	5.00	26.50	25.50	26.00	5.00	25.00	25.00	25.00	5.00	25.00	26.50	25.00
pH(unfiltered)	6.83	6.71	6.63	6.09	7.03	6.42	6.42	6.11	7.12	6.91	6.91	6.50	7.49	6.46	6.46	6.32	7.44	7.84	7.84	6.92
pH(unfiltered)	6.83	6.71	6.63	6.09	7.03	6.42	6.42	6.11	7.12	6.91	6.91	6.50	7.49	6.46	6.46	6.32	7.44	7.84	7.84	6.92
Phenanthrene	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00
Phenol	5.00	50.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.50	5.00
Potassium	1000.00	750.00	920.00	670.00	1000.00	1120.00	910.00	1310.00	8180.00	9290.00	10300.00	10200.00	5000.00	5070.00	4140.00	4310.00	2000.60	2250.00	2050.00	4050.00
Potassium(dis)	1000.00	600.00	620.00	1000.00	850.00	760.00	8180.00	7160.00		7330.00	6000.00	4710.00		4110.00	2000.00	1400.00		3390.00		
Propanol, 1-, n-Propyl alcohol	2.50	50.00	50.00	50.00	2.50	50.00	50.00	50.00	2.50	50.00	50.00	50.00	2.50	50.00	50.00	50.00	2.50	50.00	50.00	50.00
Propanol, 2-, isopropyl alcohol	2.50	50.00	50.00	50.00	2.50	50.00	50.00	50.00	2.50	50.00	50.00	50.00	2.50	50.00	50.00	50.00	2.50	50.00	50.00	50.00
Propylbenzene, n-, 1-Phenylpropane	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50	1.00	2.50	2.50	2.50
Selenium	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Selenium (dis)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Silver	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	20.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Silver (dis)	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Silvex	0.50	0.13		0.13	0.50	0.13		0.13	0.50	0.13		0.13	0.50	0.13		0.13	0.50	0.13	0.13	0.13
Sodium	8000.00	17800.00	17100.00	17800.00	14000.00	17100.00	19600.00	143000.00	24000.00	29300.00	32100.00	34600.00	31000.00	25800.00	25400.00	26700.00	4000.00	4940.00	4200.00	5380.00
Sodium(dis)	10000.00	14300.00		15600.00	16000.00	17100.00		16100.00	26000.00	26500.00		29500.00	36000.00	25800.00		27500.00	6000.00	4160.00		5690.00
Specific Conductance		1250.00	1210.00	1150.00		1205.00	1205.00	1150.00		973.00	973.00	1120.00		1140.00	1140.00	1360.00		565.00	565.00	550.00
Styrene	0.50	5.00	5.00	5.00	0.50	5.00	5.00	5.00	0.50	5.00	5.00	5.00	0.50	5.00	5.00	5.00	0.50	5.00	5.00	5.00
Sulfates	5000.00	11000.00	5000.00	13000.00	9000.00	5000.00	5000.00	5000.00	56000.00	46000.00	34000.00	49000.00	65000.00	30000.00	28000.00	27000.00	22000.00	23000.00	24000.00	25000.00

Genshans, inc.

Table 4.2. Summary of background groundwater concentrations (continued).

Compound	Well Number and Date of Sampling																			
	G109				G109A				G113				G113A				G120B			
	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94	Aug. 93	Nov. 93	Feb. 94	May 94
Tetrachloroethane, 1,1,1,2-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Tetrachloroethane, 1,1,2,2-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Tetrachloroethene, 1,1,2,2-	0.50	2.50	2.50	2.50	1.80	2.50	2.50	2.50	0.50	2.50	2.50	2.50	22.00	25.00	20.00	26.00	10.00	8.00	6.00	5.00
Tetrahydrofuran	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	42.00	13.00	2.50	2.50
Thallium	100.00	1.00	1.00	1.00	100.00	1.00	1.00	1.00	100.00	1.00	1.00	1.00	100.00	1.00	1.00	1.00	100.00	1.00	1.00	1.00
Thallium (dis)	100.00	1.00	1.00	1.00	100.00	1.00	1.00	1.00	100.00	1.00	1.00	1.00	100.00	1.00	1.00	1.00	100.00	1.00	1.00	1.00
Tin		100.00	100.00	100.00		100.00	100.00	100.00		100.00	100.00	100.00		100.00	100.00	100.00		100.00	100.00	100.00
Tin (dis)		100.00	100.00	100.00		100.00	100.00	100.00		100.00	100.00	100.00		100.00	100.00	100.00		100.00	100.00	100.00
Toluene	10.00	2.50	2.50	2.50	10.00	2.50	2.50	2.50	10.00	2.50	2.50	2.50	10.00	2.50	2.50	2.50	10.00	2.50	2.50	2.50
Total Dissolved Solids (TDS)	985.00	774.00	760.00	912.00	670.00	672.00	720.00	0.00	720.00	772.00	416.00	720.00	728.00	812.00	850.00	876.00	305.00	324.00	326.00	328.00
Total Organic Carbon (TOC)	2.24	14.00	1.30	1.10	1.66	12.00	0.50	7.70	2.75	14.00	2.50	2.80	2.57	7.80	0.50	4.20	1.00	1.40	0.50	0.50
Total Organic Halogens (TOX)	0.01	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.06	0.07	0.11	0.09	0.05	0.02	0.02	0.05
Toxaphene	0.25	0.50	0.50	1.00	0.25	0.50	0.50	0.25	0.50	0.50	0.50	0.50	0.25	0.50	0.50	1.25	0.25	0.50	0.50	0.50
Trichlorobenzene, 1,2,3-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Trichlorobenzene, 1,2,4-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Trichloroethane, 1,1,1-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	12.00	9.00	8.00	2.50
Trichloroethane, 1,1,2-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Trichloroethylene, Trichloroethene	0.50	2.50	2.50	2.50	1.40	2.50	2.50	2.50	0.50	2.50	2.50	2.50	52.00	46.00	49.00	66.00	16.00	12.00	11.00	10.00
Trichlorofluoromethane	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Trichlorophenoxyacetic acid, 2,4,5-	0.50	0.13		0.13	0.50	0.13		0.13	0.50	0.13		0.13	0.50	0.13		0.13	0.50	0.13	0.13	
Trichloropropane, 1,2,3-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Trimethylbenzene, 1,2,4-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Trimethylbenzene, 1,3,5-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Vanadium	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	100.00	70.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Vanadium (dis)	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Vinyl acetate	0.50	5.00	5.00	5.00	0.50	5.00	5.00	5.00	0.50	5.00	5.00	5.00	0.50	5.00	5.00	5.00	0.50	5.00	5.00	5.00
Vinyl chloride	0.50	1.00	1.00	1.00	0.50	1.00	1.00	1.00	0.50	1.00	1.00	1.00	17.00	9.00	16.00	1.00	0.50	1.00	1.00	1.00
Xylene, m-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Xylene, o-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Xylene, p-	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Xylenes	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50	0.50	2.50	2.50	2.50
Zinc	8800.00	2830.00	53100.00	5960.00	5050.00	5860.00	9270.00	61200.00	4600.00	1850.00	8030.00	3990.00	862.00	1340.00	1095.00	290.00	20.00	310.00	20.00	60.00
Zinc (dis)	4630.00	2230.00	5830.00	1890.00	3100.00	3440.00	5120.00	4010.00	498.00	440.00	380.00	320.00	665.00	860.00	1500.00	150.00	20.00	5.00	5.00	5.00

Notes:

All concentrations expressed in µg/L.

< Indicates concentration was not detectable at that detection limit

- na not analyzed

Additional chemical data used in statistical analysis is provided in Appendix C.

bedrock aquifer. The monitoring programs used to determine the effectiveness of the selected remedial action as well as future detection monitoring programs for this facility rely primarily upon wells screened within the downgradient sand and gravel aquifer. Although this could present a potential inconsistency between background groundwater quality and downgradient water quality, the hydrogeological report (GeoTrans, 1995c) and numerical flow modeling (GeoTrans, 1995a) indicate that groundwater in the dolomite upgradient of the facility discharges to the sand and gravel aquifer as the groundwater moves downgradient. Specifically, particle tracking presented in the calibrated groundwater flow model report shows that the flowpath of groundwater particles is from the screened zone of each upgradient background well into the unconsolidated sediments located beneath the landfill. In other words, the chosen background well locations monitor incoming groundwater located upgradient of the landfill. Therefore, the AGQS concentrations presented are based on the concentrations detected in the background bedrock monitoring wells and are also representative of both the bedrock and the shallow deposits at the site. Nonetheless, there is a possibility that future differences in the groundwater geochemistries between the two hydrostratigraphic units (such as after cleanup and during detection monitoring) may make the use of bedrock AGQS values for the sand and gravel unit inappropriate. In this instance, separate AGQS values will be developed for the two units.

The existing facility is downgradient of the ACME Solvents Superfund Site and all of the upgradient wells except G109 exhibit varying degrees of impact from the ACME Solvent Facility. The impacts are primarily limited to organic compounds of which the chlorinated ethenes and chlorinated ethanes are the most prevalent. However, the list of compounds of concern at the ACME Solvent facility covers inorganics, volatile organics, and semi-volatile organics. The highest levels of organic compounds are found in well nest G113/G113A and G120B.

It should be noted that the background concentrations are similar to concentrations observed in wells screened in unconsolidated sediments to the south of the existing facility with the exception of nitrate. Nitrate levels are elevated to the south as a result of agricultural activities. High levels of nitrate above the 35 IAC 620 class I groundwater quality standards

are also observed in Kilbuck creek upstream of the facility and throughout shallow monitoring wells within the floodplain of Kilbuck Creek. Results of recent water samples collected from Kilbuck Creek are presented in Appendix C.

4.1.3 STATISTICAL ANALYSIS FOR AGQS DETERMINATION

The AGQS values for parameters with a greater than 50 percent detection frequency were determined using an interval estimate. Interval estimates can provide a statement of the probability that the interval contains the true population value, or an estimate of the likelihood that a single data point with a specified magnitude comes from the sample population of concern. Intervals estimates that predict the likelihood of a sample coming from a known population are called prediction intervals or prediction limits (Helsel and Hirsch, 1992). The prediction limit was used to provide an upper or lower limit for the concentration of all compounds with the above stated detection frequency. The mathematical equation for determining the prediction limit is as follows:

The 99 percent Prediction Limit (at the 99 percent Confidence Level) method is given as:

$$99\% \text{ CL} = X \pm s(t) \sqrt{1 + 1/n}$$

where:

- x = mean of previous sampling results
- s = standard deviation of previous sampling results
- t = Student's one tailed t value at n-1 degrees of freedom and $\alpha = 1\%$
- n = number of previous sampling results

The above referenced method is generally considered appropriate for data in which 15 percent or less of the samples are below the detection limit. If greater than 15 percent of the samples and less than 50 percent of the samples are below the detection limit it has been suggested that Cohens adjustment to the mean should be incorporated into the statistical interval test (USEPA, 1989). This adjustment was performed prior to determining the

Prediction Limit for six parameters and is denoted by a "C qualifier. Cohens adjustment to the mean utilizes the Practical Quantitation Limit for non-detects when determining the adjusted mean and standard deviation. The method for calculating Cohens adjustment to the mean is presented in Appendix B. Nondetects for all other parameters were treated by replacing the reported value with one half the Reporting Limit prior to determining the prediction limit for data sets having less than 50 percent non detects.

AGQS's for those parameters in which the percent of nondetects in an individual well was more than 50 percent and less than 99 percent were determined by substituting the maximum reported value from the particular data set. For those parameters in which all of the sampling analytical results are below the Reporting Limit, the Practical Quantitation Limit was used to define the AGQS. The background data set contains reports generated from several different laboratories and as a result contains several different reporting limits. Since there is no uniform consensus on how to treat censored data with multiple detection limits it was decided to use the maximum reported detection limit when determining the AGQS for compounds with 100 percent non detects. In situations where there are multiple detection limits and each limit represents a true detection limit, it is more appropriate to use the highest detection limit and assume that all detection limits below the highest limit are censored. In general, this assumption provides a less biased estimate when performing subsequent statistical calculations.

Since the method utilized to determine the prediction limit is a normal theory test it is necessary to insure that the data collected for each parameter of interest can be described by a normal distribution. Failure of the data to follow a normal distribution can result in erroneous conclusions about the sample population of interest when the statistical analysis assumes data normality. A simple test for normality can be performed by determining the coefficient of variation for a sample population (USEPA, 1989). The coefficient of variation (CV) is calculated by dividing the standard deviation with the sample mean and is expressed as S/\bar{x} . A CV greater than one indicates that the data population is not normal. A discussion concerning the use of the coefficient of variation test for normality is presented in Appendix B. If the data does not conform to the normal distribution a nonparametric

analysis, such as a Rank-Sum test, is required or the data may be transformed to yield a normal population. Although several of the parameters met the test for normality, a normal data population is the exception rather than the rule when characterizing groundwater chemistry. To simplify the statistical analysis, all of the data for parameters (analyzed using the prediction limit or received Cohens adjustment to the mean prior to determining a prediction limit) were assumed to conform to a lognormal distribution. These data sets were transformed by determining the log of the actual data. In all instances a log transformation provided a good positive test for normality using the coefficient of variation. A comparison of the coefficient of variation using transformed and untransformed data is presented in the statistical summary (Appendix B). The prediction limit was determined using the transformed data and retransformed back into original units by taking the inverse log function of the data.

The applicable Groundwater Quality Standards, as determined using the preceding methods, are presented in Table 4.3. These values represent the seasonal, temporal, and any artificially induced variations in groundwater quality. Therefore, any observed constituent concentration above its AGQS may be considered a statistically significant value above background levels.

4.2 OPERATION AND MAINTENANCE MONITORING PROGRAM

The Operation & Maintenance monitoring program is designed in accordance with 35 IA. 811.319(b)(1) and (5) and 35 IAC 811.324(c). It is a continuation of assessment monitoring performed during previous studies to determine the impacts this facility has upon groundwater resources. The wells proposed for the O&M network are listed in Table 3.1, and are described in Section 3.1.1. In addition, this O&M monitoring program is designed to address the requirements of the Consent Decree, Record of Decision, and the Statement of Work. The overall objectives of the O&M program will be to provide the information necessary to assess the effectiveness of the remedial action proposed for the Groundwater Management Zone, and to determine the necessity for additional corrective measures at the facility.

Table 4.3. Summary of applicable groundwater quality standards (prediction limit).

<u>PARAMETER</u>	<u>CAS Number</u>	<u>Method</u>	<u>UNITS</u>	<u>AGOS</u>
<u>FIELD DATA</u>				
Bottom of Well<MSL>	n/a	Field	ft	
Depth to Water<BLGS>	n/a	Field	ft	
Depth to Water<BLTOIC>	n/a	Field	ft	
Groundwater Elev. <MSL>	n/a	Field	ft	
pH(unfiltered)	n/a	Field	units	8.1:
pH(unfiltered)	n/a	Field	units	5.4:
Specific Conductance<unfiltered, umhos/cm 25C>	n/a	Field	umhos	2350.0
Water Temp<deg. F>	n/a	Field	deg	
<u>LIST 2</u>				
<u>MISCELLANEOUS CONSTITUENTS</u>				
Alkalinity (total)	n/a	E310.2	mg/l	1522.91
Biological Oxygen Demand (BOD)	n/a	E405.1	mg/l	4.01
Chemical Oxygen Demand (COD)	n/a	E410.4	mg/l	50.01
Oil (Hexane soluble or equiv)	n/a	E413.1	mg/l	2.51
Total Dissolved Solids (TDS)	n/a	E160.1	mg/l	1755.81
Total Organic Carbon (TOC)	n/a	E415.1	mg/l	4301.01
Total Organic Halogens (TOX)	n/a	E402.0	mg/l	0.11
<u>LIST 3</u>				
<u>INORGANIC PARAMETERS</u>				
Aluminum	7429-90-5	E200.7	ug/l	66602.55
Aluminum (dis)			ug/l	1210.01
Ammonia	7664-41-7	E350.2	ug/l	900.01
Antimony	7440-36-0	E200.7	ug/l	500.01
Anutimony (dis)			ug/l	250.01
Arsenic	7440-18-2	E200.7	ug/l	10.00
Arsenic (dis)			ug/l	1.00
Banum	7440-59-3	E200.7	ug/l	225180.55
Banum (dis)			ug/l	33143.15
Beryllium	7440-41-7	E200.7	ug/l	5.00
Beryllium (dis)			ug/l	5.00
Boron	7440-42-8	E200.7	ug/l	200.00
Boron (dis)			ug/l	98.00
Cadmium	7440-43-9	E210.2	ug/l	45.00
Cadmium (dis)			ug/l	5.00
Calcium	7440-70-2	E200.7	ug/l	*****
Calcium (dis)			ug/l	423889.30
Chloride	6887-00-6	E355.1	ug/l	87511.36
Chromium	7440-47-3	E200.7	ug/l	5516.15
Chromium (dis)			ug/l	100.00
Cobalt	7440-48-4	E200.7	ug/l	50.00
Cobalt (dis)			ug/l	100.00
Copper	7440-50-8	E200.7	ug/l	1887.83
Copper (dis)			ug/l	20.00
Cyanide (Total as CN-)	57-12-5	E335.3	ug/l	34.00
Fluoride (Total as F-)	7782-41-4	E340.2	ug/l	173.35
Iron (Total)	7439-89-6	E200.7	ug/l	446696.29
Iron (dis)			ug/l	4530.00
Lead	7439-92-1	E139.1	ug/l	41230.83
Lead (dis)			ug/l	4.00
Magnesium	7439-95-4	E200.7	ug/l	*****
Magnesium (dis)			ug/l	109108.82
Manganese	7439-96-5	E200.7	ug/l	12381.45
Manganese (dis)			ug/l	1479.53
Mercury	7439-97-6	E145.1	ug/l	0.40
Mercury (dis)			ug/l	0.10
Nickel	7440-02-0	E200.7	ug/l	1757.64
Nickel (dis)			ug/l	40.00
Nitrate (as Nitrogen)	7727-37-9	E355.1	ug/l	11738.90
Potassium	7440-09-7	*V	ug/l	29005.82
Potassium(dis)	7440-09-7	*V	ug/l	28193.91
Selenium	7782-49-2	E170.2	ug/l	4.00
Selenium (dis)			ug/l	2.00
Silver	7440-22-4	E200.7	ug/l	20.00
Silver (dis)			ug/l	10.00
Sodium	7440-23-5	E200.7	ug/l	164789.66
Sodium(dis)	7440-23-5	E200.7	ug/l	93020.42
Sulfates	4803-79-3	E373.1	ug/l	179370.07
Tharlium	7440-23-0	E179.1	ug/l	200.00
Thalithium (dis)			ug/l	200.00
Tin	7440-51-5	200	ug/l	200.00

Table 4.3. Summary of applicable groundwater quality standards (prediction limit)
(continued).

PARAMETER	CAS Number	Method	UNITS	AGOS
Tin (dis)			ug/l	200.0
Vanadium	7440-62-2	E200.7	ug/l	100.0
Vanadium (dis)			ug/l	50.0
Zinc	7440-66-6	E200.7	ug/l	622283.0
Zinc (dis)			ug/l	236072.40

* Analytical Methods for Flame Spectrophotometry, Varian, 1979

LIST 4
ORGANIC CONSTITUENTS

2,4-D;2,4-dichlorophenoxy-acetic acid	94-75-7	SW8260	ug/l	2.00
Acetone;2-Propane	67-64-1	SW8270	ug/l	10.00
Acrolein	107-02-8	SW8080	ug/l	100.00
Acrylonitrile;2-Propenenitrile	107-13-1	SW8150	ug/l	10.00
Alachor*	15972-60-8	SW8015	ug/l	2.00
Aldicarb; Temik	116-06-3	E619	ug/l	1.00
Aldrin; Aldrex	309-00-2		ug/l	0.50
Atrazine	1912-34-9		ug/l	3.00
Benzene*	71-43-2		ug/l	2.80
Benzoic Acid	65-85-0		ug/l	500.00
bis (2-Chloroethoxy) methane	111-91-1		ug/l	100.00
bis (2-Ethylhexyl) phthalate	117-81-7		ug/l	72.00
bis Chloromethyl ether	542-88-1		ug/l	
Bromobenzene; Phenyl bromide	108-86-1		ug/l	5.00
Bromoform; Chlorobromomethane	74-97-5		ug/l	5.00
Bromodichloromethane; Dibromochloromethane	75-27-4		ug/l	5.00
Bromoform; Tribromomethane	75-25-2		ug/l	5.00
Bromomethane; Methyl bromide	74-83-9		ug/l	10.00
Butanol 1,n-butyl alcohol	71-36-3		ug/l	320.00
Butanol 1,2:sec-butyl alcohol	78-92-2		ug/l	260.00
Butanone, 2-; Methyl ethyl ketone; MEK	73-93-3		ug/l	5.00
Butylbenzene, n-; 1-Phenylbutane	104-51-8		ug/l	5.00
Butylbenzene, sec-; (1-Methylpropyl)benzene	135-98-8		ug/l	5.00
Butylbenzene, tert-; (1,1-Dimethylethyl)benzene	98-06-6		ug/l	5.00
Butylbenzyl phthalate	85-68-7		ug/l	100.00
Carbofuran	1563-66-2		ug/l	10.00
Carbon disulfide	75-15-0		ug/l	5.00
Carbon tetrachloride	56-23-5		ug/l	5.00
Chlordane*	57-74-9		ug/l	1.20
Chlorobenzene; Monochlorobenzene	108-90-7		ug/l	5.00
Chlorodibromomethane; Dibromochloromethane	124-48-1		ug/l	5.00
Chloroethane; ethyl chloride	75-00-3		ug/l	10.00
Chloroethyl Vinyl Ether, 2-; (2-Chloroethoxy)ethene	110-75-8		ug/l	10.00
Chloroform; Trichloromethane	67-66-3		ug/l	5.00
Chloronaphthalene, 2-	91-58-7		ug/l	100.00
Chlorotoluene, o-	95-49-8		ug/l	5.00
Chlorotoluene, p-	106-43-4		ug/l	5.00
Cresol, p-; cresol, 4-methylphenol	106-44-5		ug/l	100.00
Cumene; (1-Methylethyl)benzene; Isopropylbenzene	98-82-8		ug/l	5.00
Cymene; p-Isopropyltoluene, Dolcymene	25515-15-1		ug/l	5.00
DDD; 1,1'-(2,2-dichloroethylidene)bis[4chlorobenzene]	72-54-8		ug/l	0.25
DDE; 1,1'-(dichloroethenylidene)bis[4chlorobenzene]	72-55-9		ug/l	0.25
DDT; 1,1'-(2,2,2-Trichloroethylidene)bis[4-chlorobenzene]	50-29-3		ug/l	0.25
Di-n-butyl phthalate; Dibutyl phthalate	84-74-2		ug/l	100.00
Dibromo-3-chloropropane, 1,2-; (DBCP)	96-12-8		ug/l	5.00
Dichloro-2-butene, trans-1,4-	110-57-6		ug/l	5.00
Dichlorobenzene, 1,2; o-Dichlorobenzene	95-50-1		ug/l	5.00
Dichlorobenzene, 1,3; m-Dichlorobenzene	541-73-1		ug/l	5.00
Dichlorobenzene, 1,4; p-Dichlorobenzene	106-46-7		ug/l	3.70
Dichlorodifluoromethane; Difluorodichloromethane; Freon	75-71-8		ug/l	19.00
Dichloroethane, 1,1-; Ethylidene chloride	75-34-3		ug/l	31.00
Dichloroethane, 1,2-; ethylene dichloride*	107-06-2		ug/l	2.50
Dichloroethylene, 1,1-	75-35-4		ug/l	2.50
Dichloroethylene, 1,2-	540-59-0		ug/l	150.00
Dichloroethylene, cis-1,2-	156-59-0		ug/l	150.00
Dichloroethylene, trans-1,2-	156-60-5		ug/l	5.00
Dichloropropane, 1,2-*	78-87-5		ug/l	6.00
Dichloropropane, 1,3-; Trimethylene dichloride	142-28-9		ug/l	5.00
Dichloropropane, 2,2-; Isopropylene chloride	594-20-7		ug/l	5.00
Dichloropropene, 1,1-; 1,1-Dichloropropylene	563-58-6		ug/l	5.00
Dichloropropene, 1,3-; 1,3-Dichloropropylene	542-75-6		ug/l	5.00
Dichloropropene, cis-1,3-	10060-01-2		ug/l	5.00
Dichloropropene, trans-1,3-	10061-02-6		ug/l	5.00
Dieldrin	60-57-1		ug/l	0.25
Diethyl phthalate	84-66-2		ug/l	100.00
Difluorobenzene, 1,4-; p-Difluorobenzene	540-36-3		ug/l	5.00

Table 4.3. Summary of applicable groundwater quality standards (prediction limit)
(continued).

PARAMETER	CAS Number	Method	UNITS	AGOS
Dimethyl phthalate	131-11-3		ug/l	100.00
Dimethylphenol,2,4-	1300-71-6		ug/l	100.00
Endosulfan I	959-98-8		ug/l	0.12
Endosulfan II	33213-65-9		ug/l	0.25
Endosulfan Sulfate	1031-07-8		ug/l	0.25
Endrin	72-20-8		ug/l	0.25
Endrin Aldehyde	7421-93-4		ug/l	0.25
Endrin Ketone			ug/l	0.25
Ethyl acetate	141-78-6		ug/l	5.00
Ethyl Alcohol; Ethanol	64-17-5		ug/l	100.00
Ethyl Methacrylate	97-63-2		ug/l	5.00
Ethylibenzene	100-41-4		ug/l	5.00
Ethylene dibromide (EDB); 1,2-Dibromoethane	106-93-4		ug/l	5.00
gamma-BHC; 1,2,3,4,5,6-Hexachlorocyclohexane; Lindan	58-89-9		ug/l	0.50
Heptachlor*	76-44-8		ug/l	0.50
Heptachlor Epoxide*	1024-57-3		ug/l	0.50
Hexachlorobutadiene	87-68-3		ug/l	100.00
Hexanone, 2-; Methyl butyl ketone	591-78-6		ug/l	10.00
Iodomethane; Methyl iodide	74-88-4		ug/l	10.00
Isophorone	78-59-1		ug/l	100.00
Methochlor	72-43-5		ug/l	1.20
Methyl chloride; chloromethane	74-87-3		ug/l	10.00
Methyl-2-pentanone, 4-, Methyl isobutyl ketone	108-10-1		ug/l	10.00
Methylene bromide; Dibromoethane	74-95-3		ug/l	5.00
Methylene chloride; Dichloromethane	75-09-2		ug/l	8.00
Naphthalene	91-20-3		ug/l	100.00
Nitrobenzene	98-95-3		ug/l	100.00
Nitrophenol, 4-; p-Nitrophenol	100-07-7		ug/l	500.00
Parathion; O,O-Diethyl phosphorothioic acid	56-58-2		ug/l	1.00
PCBs; Polychlorinated biphenyls*	1336-56-3		ug/l	2.50
Pentachlorophenol*	87-86-5		ug/l	500.00
Phenanthrene	85-01-8		ug/l	100.00
Phenol	108-95-2		ug/l	100.00
Propanol, 1-; n-Propyl alcohol	71-23-8		ug/l	100.00
Propanol, 2-; isopropyl alcohol	67-63-0		ug/l	160.00
Propylbenzene, n-; 1-Phenylpropane	103-65-1		ug/l	5.00
Silvex, 2-(2,4,5-trichlorophenoxy)propionic acid; 2,4,5-TP	93-72-1		ug/l	1.00
Styrene, Ethenylbenzene	100-42-5		ug/l	10.00
Tetrachloroethane, 1,1,1,2-	630-20-6		ug/l	5.00
Tetrachloroethane, 1,1,2,2-	79-34-5		ug/l	5.00
Tetrachloroethene, 1,1,2,2-; Tetrachloroethylene*	127-18-4		ug/l	26.00
Tetrahydrofuran; Tetramethylene oxide	109-99-9		ug/l	42.00
Toluene; Methylbenzene	108-88-3		ug/l	20.00
Toxaphene	8001-35-2		ug/l	2.50
Trichlorobenzene, 1,2,3-	87-61-6		ug/l	5.00
Trichlorobenzene, 1,2,4-	120-82-1		ug/l	5.00
Trichloroethane, 1,1,1-; Methylchloroform	71-55-6		ug/l	12.00
Trichloroethane, 1,1,2-	79-00-5		ug/l	5.00
Trichloroethylene; Trichloroethene	79-01-6		ug/l	66.00
Trichlorofluoromethane; Fluorotrichloromethane; Freon 11	75-69-4		ug/l	5.00
Trichlorophenoxyacetic acid, 2,4,5-, 2,4,5-T	93-76-5		ug/l	1.00
Trichloropropane, 1,2,3-	96-18-4		ug/l	5.00
Trimethylbenzene, 1,2,4-; Pseudocumene	95-63-6		ug/l	5.00
Trimethylbenzene, 1,3,5-; Mesitylene	108-67-8		ug/l	5.00
Vinyl acetate; Ethenyl ester acetic acid	108-05-4		ug/l	10.00
Vinyl chloride; Chloroethene*	75-01-4		ug/l	17.00
Xylene, m-	108-38-3		ug/l	5.00
Xylene, o-	95-47-6		ug/l	5.00
Xylene, p-	106-42-3		ug/l	5.00
Xylenes	1330-20-7		ug/l	5.00

4.2.1 SAMPLING PARAMETERS AND FREQUENCY

In accordance with 35 IAC 811.319(b)(5), samples will be collected semi-annually for both inorganic and organic compounds that are present within the leachate and annually for the full list of inorganics and organics currently required under 35 IAC 811.319 and 814 Subpart C. The proposed monitoring program is presented in Table 4.4. In accordance with 811.319(a)(2)(B) and 811.319(b)(5)(E), the proposed program reduces the number of wells and constituents that shall be monitored during three quarters of the year. The monitoring program is composed of three separate constituent lists and two sets of monitoring wells. It is designed to provide semi-annual monitoring for detectable leachate constituents, routine indicator monitoring during alternate quarters, and an annual scan for inorganics and organics.

Routine indicator parameters are presented in List G1 of Table 4.4. The list of indicator constituents is slightly more comprehensive than a “typical” list. The list contains compounds that are sensitive to changes in the redox chemistry, are mobile, or are amenable to biodegradation, and as such will be useful for determining the effectiveness of the proposed corrective action (air sparging and source reduction). The selected monitoring wells in list W1 and W2 will provide information at the boundaries of the GMZ and in areas where groundwater impacts are greatest.

Semi-annual monitoring for detectable leachate constituents is provided in Lists G2 and G3 of Table 4.4. List G2 is composed of detectable leachate constituents and is the result of a substantial amount of historical data that fully characterizes the spatial and temporal quality of the leachate found within the existing facility. In accordance with 35 IAC 811.319(b)(5)(A), sampling and analysis of the list of constituents at 40 CFR 258 Appendix II will be performed on two wells (G117 and MW106) within the GMZ. If any parameters are detected that are not currently in list G2, the wells will be resampled and, upon confirmation, any new parameters will be added to Lists G2 and G3 as necessary. As with the routine monitoring, sampling for List G2 will be performed on wells in List W1 and W2.

The annual inorganic and organic scan “typical” for other 35 IAC 814 Subpart C facilities is presented in List G3. In accordance with 811.319(a)(2-3) and 811.319(b)(5)(E), List G3 provides annual sampling and analysis for organics and inorganic constituents and also will be used to provide the required second semi-annual monitoring event for leachate detectable constituents. The full list of wells in Table 3.1 will be utilized during this monitoring event.

4.2.2 STATISTICAL ANALYSIS

During the O&M phase of monitoring, mass reduction of the contaminant plume is the primary objective to be evaluated. Although, the analytical data gathered during the O&M monitoring program will be routinely compared to background data with the statistical methods used to develop the Applicable Groundwater Quality Standards, some measure of trend must be incorporated into the statistical analysis of the wells within the Groundwater Management Zone to allow a determination of the system performance. The data that would allow a trend analysis must be gathered during the operation of remedial action and analyzed after a sufficient data set has been compiled. Since the anticipated startup date is dependent on approval of the system design, no specific analysis to determine concentration trends is presented with this submittal. However, a test for trend will be presented with the prefinal Remedial Design (95 percent) Report.

4.3 VERIFICATION MONITORING PROGRAM

At the end of the active groundwater extraction period, it is anticipated that Verification monitoring will be conducted to determine compliance with the groundwater cleanup standards. The purpose of Verification monitoring is to assess whether each targeted leachate constituent concentration is below its Applicable Groundwater Quality Standard (prediction limit). It is anticipated that the Verification phase will coincide with a period in which the operation of the groundwater extraction system will be adjusted in order to increase mass removal efficiencies.

Table 4.4. Groundwater sampling parameter list for O&M, Verification, and Detection Monitoring Programs.

<u>LIST W1</u>	<u>LIST W2</u>	<u>LIST W3</u>
G109	G116A	B15R
G109A	G117	G115
G113	G132	G118R
G113A	G34S	G118A
G120B	G34D	G33D
	G35D	G36
	G37D	G37S
	MW106	G38
	P1	Proposed
		G39
		Proposed
		G40
		Proposed
		P3R
		P4R

<u>Sampling Quarter</u>	<u>Analytical Parameters Well List</u>
Jan-Feb	List G1
April-May	List G2
July-Aug	List G1
Oct-Nov	List G3
	W1 & W2
	W1 & W2
	W1 & W2
	W1 & W2 & W3

Table 4.4. Groundwater sampling parameter list for O&M, Verification, and Detection Monitoring Programs (continued).

LIST G1 - (Indicator List)

FIELD PARAMETERS

	CAS Number	Method	UNITS
Bottom of Well<MSL>	n/a	Field	ft
Depth to Water<BLGS>	n/a	Field	ft
Depth to Water<BLTOIC>	n/a	Field	ft
Groundwater Elev. <MSL>	n/a	Field	ft
pH(unfiltered)	n/a	Field	units
Specific Conductance<unfiltered, umhos/cm 25C>	n/a	Field	umhos
Water Temp<deg. F>	n/a	Field	deg

MISCELLANEOUS CONSTITUENTS

	CAS Number	Method	UNITS
Alkalinity (total)	n/a	E310.2	mg/l
Biological Oxygen Demand (BOD)	n/a	E405.1	mg/l
Chemical Oxygen Demand (COD)	n/a	E410.4	mg/l
Total Dissolved Solids (TDS)	n/a	E160.1	mg/l
Total Organic Carbon (TOC)	n/a	E415.1	mg/l

INORGANIC PARAMETERS

	CAS Number	Method	UNITS
Ammonia	7664-41-7	E350.2	ug/l
Arsenic	7440-38-2	E206.2	ug/l
Cadmium(dis)	7440-43-9	E213.2	ug/l
Calcium(dis)	7440-70-2	E200.7	ug/l
Chloride(dis)	6887-00-6	E325.2	ug/l
Chromium (dis)	7440-47-3	E200.7	ug/l
Copper (dis)	7440-50-8	E200.7	ug/l
Cyanide (Total as Cn-)	57-12-5	E335.3	ug/l
Iron (dis)	7439-89-6	E200.7	ug/l
Magnesium(dis)	7439-95-4	E200.7	ug/l
Manganese(dis)	7439-96-5	E200.7	ug/l
Nickel (dis)	7440-02-0	E200.7	ug/l
Nitrate (as Nitrogen)	7727-37-9	E353.2	ug/l
Potassium(dis)	7440-09-7	*V	ug/l
Sodium(dis)	7440-23-5	E200.7	ug/l
Sulfates	4808-79-8	E375.2	ug/l
Zinc (dis)	7440-66-6	E200.7	ug/l

LIST G2 - (Semi-Annual List of Detectable Leachate Constituents)

FIELD PARAMETERS

	CAS Number	Method	UNITS
Bottom of Well<MSL>	n/a	Field	ft
Depth to Water<BLGS>	n/a	Field	ft
Depth to Water<BLTOIC>	n/a	Field	ft
Groundwater Elev. <MSL>	n/a	Field	ft
pH(unfiltered)	n/a	Field	units
Specific Conductance<unfiltered, umhos/cm 25C>	n/a	Field	umhos
Water Temp<deg. F>	n/a	Field	deg

MISCELLANEOUS CONSTITUENTS

	CAS Number	Method	UNITS
Alkalinity (total)	n/a	E310.2	mg/l
Biological Oxygen Demand (BOD)	n/a	E405.1	mg/l
Chemical Oxygen Demand (COD)	n/a	E410.4	mg/l
Total Dissolved Solids (TDS)	n/a	E160.1	mg/l
Total Organic Carbon (TOC)	n/a	E415.1	mg/l

Table 4.4. Groundwater sampling parameter list for O&M, Verification, and Detection Monitoring Programs (continued).

LIST G2 - (Semi-Annual List of Detectable Leachate Constituents)

INORGANIC PARAMETERS	CAS Number	Method	UNITS
Aluminum (dis)			ug/l
Ammonia	7664-41-7	E350.2	ug/l
Antimony (dis)			ug/l
Arsenic (dis)			ug/l
Barium (dis)			ug/l
Beryllium (dis)			ug/l
Boron (dis)			ug/l
Cadmium(dis)			ug/l
Calcium (dis)			ug/l
Chloride(dis)	6887-00-6	E325.2	ug/l
Chromium (dis)			ug/l
Cobalt (dis)			ug/l
Copper (dis)			ug/l
Cyanide (Total as Cn-)	57-12-5	E335.3	ug/l
Fluoride (Total as F-)	7782-41-4	E340.2	ug/l
Iron (Total)	7439-89-6	E200.7	ug/l
Iron (dis)			ug/l
Lead (disl)			ug/l
Magnesium (dis)	7439-95-4	E200.7	ug/l
Manganese (dis)			ug/l
Mercury (dis)			ug/l
Nickel (dis)			ug/l
Nitrate (as Nitrogen)	7727-37-9	E353.2	ug/l
Potassium(dis)	7440-09-7	*V	ug/l
Selenium (dis)			ug/l
Silver (dis)			ug/l
Sodium[dis]	7440-23-5	E200.7	ug/l
Sulfates	4808-79-8	E375.2	ug/l
Thallium (dis)			ug/l
Tin (dis)			ug/l
Vanadium (dis)			ug/l
Zinc (dis)			ug/l

* Analytical Methods for Flame Spectrophotometry, Varian, 1979

ORGANIC CONSTITUENTS	CAS Number	Method	UNITS
Acetone;2-Propane	67-64-1	SW8270	ug/l
Anthracene	120-12-7		ug/l
Benzene*	71-43-2		ug/l
Benzoic Acid	65-85-0		ug/l
bis (2-Ethylhexyl) phthalate	117-81-7		ug/l
Butanone, 2-, Methyl ethyl ketone; MEK	73-93-3		ug/l
Carbon disulfide	75-15-0		ug/l
Chlorobenzene; Monochlorobenzene	108-90-7		ug/l
Chloroethane; ethyl chloride	75-00-3		ug/l
Cymene; p-Isopropyltoluene, Dolcymene	25515-15-1		ug/l
Dibenzofuran	132-64-9		ug/l
Dichlorobenzene, 1,4; p-Dichlorobenzene	106-46-7		ug/l
Dichloroethane, 1,1-; Ethylidene chloride	75-34-3		ug/l
Dichloroethane, 1,2-; ethylene dichloride*	107-06-2		ug/l
Dichloroethylene, 1,1-	75-35-4		ug/l
Dichloroethylene, 1,2-	540-59-0		ug/l
Dichloroethylene, cis-1,2-	156-59-0		ug/l
Dichloroethylene, trans-1,2-	156-60-5		ug/l
Dichloropropane, 1,2-*	78-87-5		ug/l
Dimethylphenol,2,4-	1300-71-6		ug/l
Di-n-octylphthalate			ug/l

Table 4.4. Groundwater sampling parameter list for O&M, Verification, and Detection Monitoring Programs (continued).

LIST G2 - (Semi-Annual List of Detectable Leachate Constituents)

ORGANIC PARAMETERS - Cont'd	CAS Number	Method	UNITS
Ethylbenzene	100-41-4		ug/l
Fluorene			ug/l
Fluoranthene			ug/l
Hexanone, 2-; Methyl butyl ketone	591-78-6		ug/l
Methyl-2-pentanone, 4-; Methyl isobutyl ketone	108-10-1		ug/l
Methylphenol, 2-, O-Cresol	95-48-7		ug/l
Methylphenol, 3-	108-39-4		ug/l
Methylphenol, 4-	106-44-5		ug/l
Methylnaphthalene, 2-			ug/l
Methylene chloride; Dichloromethane	75-09-2		ug/l
Naphthalene	91-20-3		ug/l
PCBs; Polychlorinated biphenyls*	1336-36-3		ug/l
Phenanthrene	85-01-8		ug/l
Phenol	108-95-2		ug/l
Propylbenzene, n-; 1-Phenylpropane	103-65-1		ug/l
Pyrene			
Styrene; Ethenylbenzene	100-42-5		ug/l
Tetrachloroethane, 1,1,1,2-	630-20-6		ug/l
Tetrachloroethane, 1,1,2,2-	79-34-5		ug/l
Tetrachloroethene, 1,1,2,2-; Tetrachloroethylene*	127-18-4		ug/l
Tetrahydrofuran; Tetramethylene oxide	109-99-9		ug/l
Toluene; Methylbenzene	108-88-3		ug/l
Trichloroethane, 1,1,1-; Methylchloroform	71-55-6		ug/l
Trichloroethane, 1,1,2-	79-00-5		ug/l
Trichloroethylene, Trichloroethene	79-01-6		ug/l
Trichloropropane, 1,2,3-	96-18-4		ug/l
Trimethylbenzene, 1,2,4-; Pseudocumene	95-63-6		ug/l
Trimethylbenzene, 1,3,5-; Mesitylene	108-67-8		ug/l
Vinyl chloride; Chloroethylene*	75-01-4		ug/l
Xylene, m-	108-38-3		ug/l
Xylene, o-	95-47-6		ug/l
Xylene, p-	106-42-3		ug/l
Xylenes	1330-20-7		ug/l

LIST G3 - (Annual Organics and Inorganics)

FIELD PARAMETERS	CAS Number	Method	UNITS
Bottom of Well<MSL>	n/a	Field	ft
Depth to Water<BLGS>	n/a	Field	ft
Depth to Water<BLTOIC>	n/a	Field	ft
Groundwater Elev. <MSL>	n/a	Field	ft
pH(unfiltered)	n/a	Field	units
Specific Conductance<unfiltered, umhos/cm 25C>	n/a	Field	umhos
Water Temp<deg. F>	n/a	Field	deg

MISCELLANEOUS CONSTITUENTS	CAS Number	Method	UNITS
Alkalinity (total)	n/a	E310.2	mg/l
Biological Oxygen Demand (BOD)	n/a	E405.1	mg/l
Chemical Oxygen Demand (COD)	n/a	E410.4	mg/l
Total Dissolved Solids (TDS)	n/a	E160.1	mg/l
Total Organic Carbon (TOC)	n/a	E415.1	mg/l

Table 4.4. Groundwater sampling parameter list for O&M, Verification, and Detection Monitoring Programs (continued).

LIST G3 - (Annual Organics and Inorganics)

INORGANIC PARAMETERS	CAS Number	Method	UNITS
Aluminum	7429-90-5	E200.7	ug/l
Aluminum (dis)			ug/l
Ammonia	7664-41-7	E350.2	ug/l
Antimony	7440-36-0	E200.7	ug/l
Antimony (dis)			ug/l
Arsenic	7440-38-2	E206.2	ug/l
Arsenic (dis)			ug/l
Barium	7440-39-3	E200.7	ug/l
Barium (dis)			ug/l
Beryllium	7440-41-7	E200.7	ug/l
Beryllium (dis)			ug/l
Boron	7440-42-8	E200.7	ug/l
Boron (dis)			ug/l
Cadmium	7440-43-9	E213.2	ug/l
Cadmium(dis)			ug/l
Calcium	7440-70-2	E200.7	ug/l
Calcium (dis)			ug/l
Chloride(dis)	6887-00-6	E325.2	ug/l
Chromium	7440-47-3	E200.7	ug/l
Chromium (dis)			ug/l
Cobalt	7440-48-4	E200.7	ug/l
Cobalt (dis)			ug/l
Copper	7440-50-8	E200.7	ug/l
Copper (dis)			ug/l
Cyanide (Total as Cn-)	57-12-5	E335.3	ug/l
Fluoride (Total as F-)	7782-41-4	E340.2	ug/l
Iron (Total)	7439-89-6	E200.7	ug/l
Iron (dis)			ug/l
Lead	7439-92-1	E239.2	ug/l
Lead (disl)			ug/l
Magnesium	7439-95-4	E200.7	ug/l
Magnesium (dis)	7439-95-4	E200.7	ug/l
Manganese	7439-96-5	E200.7	ug/l
Manganese (dis)			ug/l
Mercury	7439-97-6	E245.1	ug/l
Mercury (dis)			ug/l
Nickel	7440-02-0	E200.7	ug/l
Nickel (dis)			ug/l
Nitrate (as Nitrogen)	7727-37-9	E353.2	ug/l
Potassium	7440-09-7	*V	ug/l
Potassium(dis)	7440-09-7	*V	ug/l
Selenium	7782-49-2	E270.2	ug/l
Selenium (dis)			ug/l
Silver	7440-22-4	E200.7	ug/l
Silver (dis)			ug/l
Sodium	7440-23-5	E200.7	ug/l
Sodium[dis]	7440-23-5	E200.7	ug/l
Sulfates	4808-79-8	E375.2	ug/l
Thallium	7440-28-0	E279.2	ug/l
Thallium (dis)			ug/l
Tin	7440-31-5	E200.7	ug/l
Tin (dis)			ug/l
Vanadium	7440-62-2	E200.7	ug/l
Vanadium (dis)			ug/l
Zinc	7440-66-6	E200.7	ug/l
Zinc (dis)			ug/l

* Analytical Methods for Flame Spectrophotometry, Varian, 1979

Table 4.4. Groundwater sampling parameter list for O&M, Verification, and Detection Monitoring Programs (continued).

LIST G3 - (Annual Organics and Inorganics)

ORGANIC CONSTITUENTS

	CAS Number	Method	UNITS
2,4-D;2,4-dichlorophenoxy-acetic acid	94-75-7	SW8260	ug/l
Acetone;2-Propane	67-64-1	SW8270	ug/l
Acrolein	107-02-8	SW8080	ug/l
Acrylonitrile;2-Propenenitrile	107-13-1	SW8150	ug/l
Alachor*	15972-60-8	SW8015	ug/l
Aldicarb; Temik	116-06-3	E619	ug/l
Aldrin; Aldrex	309-00-2		ug/l
Atrazine	1912-24-9		ug/l
Benzene*	71-43-2		ug/l
Benzoic Acid	65-85-0		ug/l
bis (2-Chloroethoxy) methane	111-91-1		ug/l
bis (2-Ethylhexyl) phthalate	117-81-7		ug/l
bis Chloromethyl ether	542-88-1		ug/l
Bromobenzene; Phenyl bromide	108-86-1		ug/l
Bromochloromethane; Chlorobromomethane	74-97-5		ug/l
Bromodichloromethane; Dibromochloromethane	75-27-4		ug/l
Bromoform; Tribromomethane	75-25-2		ug/l
Bromomethane; Methyl bromide	74-83-9		ug/l
Butanol,1 n-Butyl alcohol	71-36-3		ug/l
Butanol 1,2;sec-butyl alcohol	78-92-2		ug/l
Butanone, 2-; Methyl ethyl ketone; MEK	73-93-3		ug/l
Butylbenzene, n-; 1-Phenylbutane	104-51-8		ug/l
Butylbenzene, sec-; (1-Methylpropyl)benzene	135-98-8		ug/l
Butylbenzene, tert-; (1,1-Dimethylethyl)benzene	98-06-6		ug/l
Butylbenzyl phthalate	85-68-7		ug/l
Carbofuran	1563-66-2		ug/l
Carbon disulfide	75-15-0		ug/l
Carbon tetrachloride	56-23-5		ug/l
Chlordane*	57-74-9		ug/l
Chlorobenzene; Monochlorobenzene	108-90-7		ug/l
Chlorodibromomethane; Dibromochloromethane	124-48-1		ug/l
Chloroethane; ethyl chloride	75-00-3		ug/l
Chloroethyl Vinyl Ether, 2-; (2-Chloroethoxy)ethene	110-75-8		ug/l
Chloroform; Trichloromethane	67-66-3		ug/l
Chloronaphthalene, 2	91-58-7		ug/l
Chlorotoluene, o-	95-49-8		ug/l
Chlorotoluene, p-	106-43-4		ug/l
Cresol, p-; cresol, 4-methylphenol	106-44-5		ug/l
Cumene; (1-Methylethyl)benzene; Isopropylbenzene	98-82-8		ug/l
Cymene; p-Isopropyltoluene, Dolcymene	25515-15-1		ug/l
Dalapon			
DDD;1,1'-(2,2-dichloroethylidene)bis[4 chlorobenzene]	72-54-8		ug/l
DDE;1,1"--(dichloroethenylidene)bis[4 chlorobenzene]	72-55-9		ug/l
DDT; 1,1'-(2,2,2-Trichloroethylidene)bis[4-chlorobenzene	50-29-3		ug/l
Di-n-butyl pthalate; Dibutyl pthalate	84-74-2		ug/l
Dibromo-3-chloropropane, 1,2-; (DBCP)	96-12-8		ug/l
Dichloro-2-butene, trans-1,4-	110-57-6		ug/l
Dichlorobenzene, 1,2; o-Dichlorobenzene	95-50-1		ug/l
Dichlorobenzene, 1,3; m-Dichlorobenzene	541-73-1		ug/l
Dichlorobenzene, 1,4; p-Dichlorobenzene	106-46-7		ug/l
Dichlorodifluoromethane; Difluorodichloromethane; Freon 12	75-71-8		ug/l
Dichloroethane, 1,1-; Ethyldiene chloride	75-34-3		ug/l
Dichloroethane, 1,2-; ethylene dichloride*	107-06-2		ug/l
Dichloroethylene, 1,1-	75-35-4		ug/l
Dichloroethylene, 1,2-	540-59-0		ug/l
Dichloroethylene, cis-1,2-	156-59-0		ug/l

Table 4.4. Groundwater sampling parameter list for O&M, Verification, and Detection Monitoring Programs (continued).

LIST G3 - (Annual Organics and Inorganics)

ORGANIC CONSTITUENTS - Cont'd

	CAS Number	Method	UNITS
Dichloroethylene, trans-1,2-	156-60-5		ug/l
Dichloropropane, 1,2-*	78-87-5		ug/l
Dichloropropane, 1,3-; Trimethylene dichloride	142-28-9		ug/l
Dichloropropane, 2,2-; Isopropylene chloride	594-20-7		ug/l
Dichloropropene, 1,1-; 1,1-Dichloropropylene	563-58-6		ug/l
Dichloropropene, 1,3-; 1,3-Dichloropropylene	542-75-6		ug/l
Dichloropropene, cis-1,3-	10060-01-2		ug/l
Dichloropropene, trans-1,3-	10061-02-6		ug/l
Dieldrin	60-57-1		ug/l
Diethyl phthalate	84-66-2		ug/l
Difluorobenzene, 1,4-; p-Difluorobenzene	540-36-3		ug/l
Dimethyl phthalate	131-11-3		ug/l
Dimethylphenol,2,4-	1300-71-6		ug/l
Dinoseb			
Endosulfan I	959-98-8		ug/l
Endosulfan II	33213-65-9		ug/l
Endosulfan Sulfate	1031-07-8		ug/l
Endothall			
Endrin	72-20-8		ug/l
Endrin Aldehyde	7421-93-4		ug/l
Endrin Ketone			ug/l
Ethyl acetate	141-78-6		ug/l
Ethyl Alcohol; Ethanol	64-17-5		ug/l
Ethyl Methacrylate	97-63-2		ug/l
Ethylbenzene	100-41-4		ug/l
Ethylene dibromide (EDB); 1,2-Dibromoethane	106-93-4		ug/l
gamma-BHC; 1,2,3,4,5,6-Hexachlorocyclohexane; Lindane	58-89-9		ug/l
Heptachlor*	76-44-8		ug/l
Heptachlor Epoxide*	1024-57-3		ug/l
Hexachlorobutadiene	87-68-3		ug/l
Hexanone, 2-; Methyl butyl ketone	591-78-6		ug/l
Iodomethane; Methyl iodide	74-88-4		ug/l
Isophorone	78-59-1		ug/l
Methoxchlor	72-43-5		ug/l
Methyl chloride; chloromethane	74-87-3		ug/l
Methyl-2-pentanone, 4-; Methyl isobutyl ketone	108-10-1		ug/l
Methylene bromide; Dibromoethane	74-95-3		ug/l
Methylene chloride; Dichloromethane	75-09-2		ug/l
Naphthalene	91-20-3		ug/l
Nitrobenzene	98-95-3		ug/l
Nitrophenol, 4-; p-Nitrophenol	100-07-7		ug/l
Parathion; 0,0-Diethyl phosphorothioic acid	56-38-2		ug/l
PCBs; Polychlorinated biphenyls*	1336-36-3		ug/l
Pentachlorophenol*	87-86-5		ug/l
Phenanthrene	85-01-8		ug/l
Phenol	108-95-2		ug/l
Picloram			
Propanol, 1-; n-Propyl alcohol	71-23-8		ug/l
Propanol, 2-; isopropyl alcohol	67-63-0		ug/l
Propylbenzene, n-; 1-Phenylpropane	103-65-1		ug/l
Silvex; 2-(2,4,5-trichlorophenoxy)propionic acid; 2,4,5-TP	93-72-1		ug/l
Simazine			
Styrene; Ethenylbenzene	100-42-5		ug/l
Tetrachloroethane, 1,1,1,2-	630-20-6		ug/l
Tetrachloroethane, 1,1,2,2-	79-34-5		ug/l

Table 4.4. Groundwater sampling parameter list for O&M, Verification, and Detection Monitoring Programs (continued).

LIST G3 - (Annual Organics and Inorganics)

ORGANIC CONSTITUENTS - Cont'd

	CAS Number	Method	UNITS
Tetrachloroethene, 1,1,2,2-; Tetrachloroethylene*	127-18-4		ug/l
Tetrahydrofuran; Tetramethylene oxide	109-99-9		ug/l
Toluene; Methylbenzene	108-88-3		ug/l
Toxaphene	8001-35-2		ug/l
Trichlorobenzene, 1,2,3-	87-61-6		ug/l
Trichlorobenzene, 1,2,4-	120-82-1		ug/l
Trichloroethane, 1,1,1-; Methylchloroform	71-55-6		ug/l
Trichloroethane, 1,1,2-	79-00-5		ug/l
Trichloroethylene, Trichloroethene	79-01-6		ug/l
Trichlorofluoromethane; Fluorotrichloromethane; Freon 11	75-69-4		ug/l
Trichlorophenoxyacetic acid, 2,4,5-; 2,4,5-T	93-76-5		ug/l
Trichloroproppane, 1,2,3-	96-18-4		ug/l
Trimethylbenzene, 1,2,4-; Pseudocumene	95-63-6		ug/l
Trimethylbenzene, 1,3,5-; Mesitylene	108-67-8		ug/l
Vinyl acetate; Ethenyl ester acetic acid	108-05-4		ug/l
Vinyl chloride; Chloroethylene*	75-01-4		ug/l
Xylene, m-	108-38-3		ug/l
Xylene, o-	95-47-6		ug/l
Xylene, p-	106-42-3		ug/l
Xylenes	1330-20-7		ug/l

4.3.1 SAMPLING PARAMETERS AND FREQUENCY

The downgradient Verification monitoring well network wells will be sampled and analyzed for the parameters shown in list G2 of Table 4.4. Verification monitoring will be conducted quarterly for a period of one year following completion of the O&M monitoring, until the provisions of 35 IAC 811.319 (d)(5)(A) are met. Once concentration levels are below MAPCs table within the zone of attenuation, and below AGQS levels of Section 811.320 for four consecutive quarters, the groundwater remediation will be completed and detection monitoring will begin.

Verification monitoring will be initiated immediately before the cessation of remediation. A single round of samples will be collected from the downgradient Verification monitoring well network and will be analyzed for the leachate MAPC constituents identified in the GIA (GeoTrans, 1995b). After collection of this round of samples, remediation will be terminated. Once typical (unstressed) aquifer conditions have been attained and sustained for a minimum of 30 days, a confirmational round of samples will be obtained from the downgradient Verification groundwater monitoring network and analyzed for the same constituents as the first round. The analytical results from this round of samples will be compared to the respective constituent prediction limits. A confirmational round will be collected 90 days (i.e., one quarter) after the first round and similarly analyzed and evaluated. If the prediction limit is not attained for a minimum of 90 percent of the monitor wells during the first two confirmation rounds, verification monitoring will be terminated, the remedial system will be reactivated, and O&M monitoring would be resumed. If the PLs are attained in 90 percent of the wells, verification monitoring will continue quarterly for six more quarters.

As stated above, in accordance with 35 IAC 811.319(d)(5)(A), the remedial action program will continue until Verification monitoring results demonstrate that monitored constituents are below the respective MAPCs within the zone of attenuation and below the respective PLs at or beyond the zone of attenuation for a period of four consecutive quarters.

If, at the end of the Verification monitoring period, the groundwater standards have not been achieved for four consecutive quarters, WRL will submit a report summarizing the situation and reassessing the cleanup technology.

4.3.2 STATISTICAL ANALYSIS

Individual well constituent concentrations at sampling points will be compared to their respective PLs and to their respective MAPCs, as appropriate following 35 IAC 811.320(e).

4.4 DETECTION MONITORING PROGRAM

The purpose of Detection monitoring is to assess whether statistically significant increases in leachate constituent concentrations within groundwater are present, indicating a release from the landfill. Detection monitoring will be conducted following completion of the groundwater remediation and leachate head reduction activities.

4.4.1 SAMPLING AND FREQUENCY

Groundwater monitoring will consist of a “typical” detection monitoring program and will be analyzed for routine indicator parameters and the annual scan presented in Lists G1 and G3 of Table 4.4. In accordance with 35 IAC 811.319 (a)(1)(B), monitoring frequency may be adjusted to an annual schedule on a well-by-well basis if either of the following conditions are met:

- All constituents monitored within the zone of attenuation have returned to a concentration less than or equal to ten percent of the MAPC (35 IAC 811.319 [a][1][B][I]).
- All constituents monitored within the zone of attenuation are less than or equal to the MAPC for eight consecutive quarters (35 IAC 811.319 (a)(1)(B)(ii)).

4.4.2 STATISTICAL ANALYSIS

The monitoring results for each well will be compared with the constituent-specific prediction limit provided in Table 4.3 and MAPCs (Table 4.5), which were determined in the Groundwater Impact Assessment (GeoTrans 1995b). Any concentration reported below the prediction limit is regarded to be within the range of normal statistical fluctuation.

Concentrations reported above the limit are potential significant increases beyond the range of normal fluctuation.

The procedure for confirming the potentially significant increases are defined in 35 IAC 811.319(a)(4)(A) and summarized below:

- i) The concentration of any routinely monitored constituent shows a progressive increase over four consecutive quarters;
- ii) The concentration of any constituent exceeds the MAPC at an established monitoring point within the zone of attenuation;
- iii) The concentration of any constituent on the extended sampling list in accordance with 811.319(a) exceeds the previously measured concentration at any established monitoring point; and
- iv) The concentration of any constituent monitored at or beyond the zone of attenuation exceeds the applicable groundwater standards of 35 IAC 811.320.

Table 4.5. Maximum allowable predicted concentrations (MAPCs) ($\mu\text{g/L}$) in verification and detection wells.

Parameter	Leachate Conc. ($\mu\text{g/l}$)	MAPC CONC. ($\mu\text{g/L}$) in Verification and Detection Wells								
		G42	G38	G41	P3R, P4R	G39	G43	G40	B15P	B15R
Run: MAPC-1 Normalized Concentration		3.73E-03	2.67E-04	8.84E-05	1.50E-03	4.75E-03	3.31E-03	9.99E-04	9.61E-05	3.56E-05
Aluminum (dis)	755.9	2.8195	0.2018	0.0668	1.1339	3.5905	2.5020	0.7551	0.0726	0.0269
alkalinity	8975700	33479.3610	2396.5119	793.4519	13463.5500	42634.5750	29709.5670	8966.7243	862.5648	319.5349
Ammonia	2023170	7546.4241	540.1864	178.8482	3034.7550	9610.0575	6696.6927	2021.1468	194.4266	72.0249
Arsenic (dis)	75	0.2798	0.0200	0.0066	0.1125	0.3563	0.2483	0.0749	0.0072	0.0027
Barium (dis)	828.3	3.0896	0.2212	0.0732	1.2425	3.9344	2.7417	0.8275	0.0796	0.0295
Boron (dis)	20700	77.2110	5.5269	1.8299	31.0500	98.3250	68.5170	20.6793	1.9893	0.7369
Cadmium (dis)	1.2	0.0045	0.0003	0.0001	0.0018	0.0057	0.0040	0.0012	0.0001	0.0000
Calcium (dis)	110072.3	410.5697	29.3893	9.7304	165.1085	522.8434	364.3393	109.9622	10.5779	3.9186
Chloride	4940500	18428.0650	1319.1135	436.7402	7410.7500	23467.3750	16353.0550	4935.5595	474.7821	175.8818
Chromium (dis)	809.7	3.0202	0.2162	0.0716	1.2146	3.8461	2.6801	0.8089	0.0778	0.0288
Cobalt (dis)	93.2	0.3476	0.0249	0.0082	0.1398	0.4427	0.3085	0.0931	0.0090	0.0033
Copper (dis)	48.3	0.1802	0.0129	0.0043	0.0725	0.2294	0.1599	0.0483	0.0046	0.0017
Cyanide (Total as Cn-)	96.2	0.3588	0.0257	0.0085	0.1443	0.4569	0.3184	0.0961	0.0092	0.0034
Fluoride (Total as F-)	404.3	1.5080	0.1079	0.0357	0.6065	1.9204	1.3382	0.4039	0.0389	0.0144
Iron (dis)	19757.5	73.6955	5.2753	1.7466	29.6363	93.8481	65.3973	19.7377	1.8987	0.7034
Lead (disl)	35.1	0.1309	0.0094	0.0031	0.0527	0.1667	0.1162	0.0351	0.0034	0.0012
Magnesium (dis)	160220	597.6206	42.7787	14.1634	240.3300	761.0450	530.3282	160.0598	15.3971	5.7038
Manganese (dis)	219.9	0.8202	0.0587	0.0194	0.3299	1.0445	0.7279	0.2197	0.0211	0.0078
Nickel (dis)	636.8	2.3753	0.1700	0.0563	0.9552	3.0248	2.1078	0.6362	0.0612	0.0227
Nitrate (as Nitrogen)	260	0.9698	0.0694	0.0230	0.3900	1.2350	0.8606	0.2597	0.0250	0.0093
Potassium(dis)	862321.9	3216.4607	230.2399	76.2293	1293.4829	4096.0290	2854.2855	861.4596	82.8691	30.6987
Silver (dis)	5	0.0187	0.0013	0.0004	0.0075	0.0238	0.0166	0.0050	0.0005	0.0002
Sodium(dis)	2315840	8638.0832	618.3293	204.7203	3473.7600	11000.2400	7665.4304	2313.5242	222.5522	82.4439
Tin (dis)	282	1.0519	0.0753	0.0249	0.4230	1.3395	0.9334	0.2817	0.0271	0.0100
Vanadium (dis)	107.3	0.4002	0.0286	0.0095	0.1610	0.5097	0.3552	0.1072	0.0103	0.0038
Zinc (dis)	398.5	1.4864	0.1064	0.0352	0.5978	1.8929	1.3190	0.3981	0.0383	0.0142
mercury	1	0.0037	0.0003	0.0001	0.0015	0.0048	0.0033	0.0010	0.0001	0.0000
sulfate	56250	209.8125	15.0188	4.9725	84.3750	267.1875	186.1875	56.1938	5.4056	2.0025
antimony	10	0.0373	0.0027	0.0009	0.0150	0.0475	0.0331	0.0100	0.0010	0.0004
beryllium	1	0.0037	0.0003	0.0001	0.0015	0.0048	0.0033	0.0010	0.0001	0.0000
selenium	10	0.0373	0.0027	0.0009	0.0150	0.0475	0.0331	0.0100	0.0010	0.0004
thallium	5	0.0187	0.0013	0.0004	0.0075	0.0238	0.0166	0.0050	0.0005	0.0002
phenol	61.1	0.2279	0.0163	0.0054	0.0917	0.2902	0.2022	0.0610	0.0059	0.0022
dichloropropane, 1,2-	2.5	0.0093	0.0007	0.0002	0.0038	0.0119	0.0083	0.0025	0.0002	0.0001
trichloroethene	2.5	0.0093	0.0007	0.0002	0.0038	0.0119	0.0083	0.0025	0.0002	0.0001
tetrachloroethylene	2.5	0.0093	0.0007	0.0002	0.0038	0.0119	0.0083	0.0025	0.0002	0.0001
hexanone, 2-	5	0.0187	0.0013	0.0004	0.0075	0.0238	0.0166	0.0050	0.0005	0.0002
chlorobenzene	2.5	0.0093	0.0007	0.0002	0.0038	0.0119	0.0083	0.0025	0.0002	0.0001
styrene	5	0.0187	0.0013	0.0004	0.0075	0.0238	0.0166	0.0050	0.0005	0.0002
chloroform	2.5	0.0093	0.0007	0.0002	0.0038	0.0119	0.0083	0.0025	0.0002	0.0001
trichloroethane, 1,1,1-	2.5	0.0093	0.0007	0.0002	0.0038	0.0119	0.0083	0.0025	0.0002	0.0001
chloroethane	5	0.0187	0.0013	0.0004	0.0075	0.0238	0.0166	0.0050	0.0005	0.0002
methylene chloride	2.5	0.0093	0.0007	0.0002	0.0038	0.0119	0.0083	0.0025	0.0002	0.0001
carbon disulfide	2.5	0.0093	0.0007	0.0002	0.0038	0.0119	0.0083	0.0025	0.0002	0.0001
dichloroethene, 1,1-	2.5	0.0093	0.0007	0.0002	0.0038	0.0119	0.0083	0.0025	0.0002	0.0001
dichloroethane, 1,1-	2.5	0.0093	0.0007	0.0002	0.0038	0.0119	0.0083	0.0025	0.0002	0.0001
dichloroethene, 1,2-, total	2.5	0.0093	0.0007	0.0002	0.0038	0.0119	0.0083	0.0025	0.0002	0.0001
Acetone,2-Propane	103.7	0.3868	0.0277	0.0092	0.1556	0.4926	0.3432	0.1036	0.0100	0.0037
Benzene	2.5	0.0093	0.0007	0.0002	0.0038	0.0119	0.0083	0.0025	0.0002	0.0001
Benzoic Acid	743.6	2.7736	0.1985	0.0657	1.1154	3.5321	2.4613	0.7429	0.0715	0.0265
bis (2-Ethylhexyl) phthalate	160.1	0.5972	0.0427	0.0142	0.2402	0.7605	0.5299	0.1599	0.0154	0.0057
Butanone, 2-, Methyl ethyl ketone; MEK	2.5	0.0093	0.0007	0.0002	0.0038	0.0119	0.0083	0.0025	0.0002	0.0001
Cresol, p.; cresol, 4-methylphenol	79.1	0.2950	0.0211	0.0070	0.1187	0.3757	0.2618	0.0790	0.0076	0.0028
Cymene, p-Isopropyltoluene, Dolcymene	37.5	0.1399	0.0100	0.0033	0.0563	0.1781	0.1241	0.0375	0.0036	0.0013
Dichlorobenzene, 1,4; p-Dichlorobenzene	28.3	0.1056	0.0076	0.0025	0.0425	0.1344	0.0937	0.0283	0.0027	0.0010
Dichloroethylene, cis-1,2-	2.5	0.0093	0.0007	0.0002	0.0038	0.0119	0.0083	0.0025	0.0002	0.0001
Dimethylphenol,2,4-	340.9	1.2716	0.0910	0.0301	0.5114	1.6193	1.1284	0.3406	0.0328	0.0121
Ethylbenzene	49	0.1828	0.0131	0.0043	0.0735	0.2328	0.1622	0.0490	0.0047	0.0017
Methyl-2-pentanone, 4-; Methyl isobutyl ketone	22.5	0.0839	0.0060	0.0020	0.0338	0.1069	0.0745	0.0225	0.0022	0.0008
Naphthalene	76.7	0.2861	0.0205	0.0068	0.1151	0.3643	0.2539	0.0766	0.0074	0.0027
PCBs, Polychlorinated biphenyls	3.1	0.0116	0.0008	0.0003	0.0047	0.0147	0.0103	0.0031	0.0003	0.0001
Phenanthrene	61.8	0.2305	0.0165	0.0055	0.0927	0.2936	0.2046	0.0617	0.0059	0.0022
Propylbenzene, n-; 1-Phenylpropane	5.6	0.0209	0.0015	0.0005	0.0084	0.0266	0.0185	0.0056	0.0005	0.0002
Tetrahydrofuran; Tetramethylene oxide	1298.4	4.8430	0.3467	0.1148	1.9476	6.1674	4.2977	1.2971	0.1248	0.0462
Toluene; Methylbenzene	119.2	0.4446	0.0318	0.0105	0.1788	0.5662	0.3946	0.1191	0.0115	0.0042
Trimethylbenzene, 1,2,4-; Pseudocumene	47.9	0.1787	0.0128	0.0042	0.0719	0.2275	0.1585	0.0479	0.0046	0.0017
Trimethylbenzene, 1,3,5-; Mesitylene	18.7	0.0698	0.0050	0.0017	0.0281	0.0888	0.0619	0.0187	0.0018	0.0007
Vinyl chloride; Chloroethene	28.5	0.1063	0.0076	0.0025	0.0428	0.1354	0.0943	0.0285	0.0027	0.0010
Xylenes	145.9	0.5442	0.0390	0.0129	0.2189	0.6930	0.4829	0.1458	0.0140	0.0052

If the above increases are observed, WRL shall notify the IEPA in writing within ten days of the observation. In addition, the subject well or wells will be resampled within 45 days of the initial observation to determine if the increase was a false positive result. WRL shall ensure that the samples and sampling protocols used during resampling will detect any statistically significant increase in the concentration of the suspected constituent in accordance with 35 IAC 811.320(e).

If the observed increase is not confirmed through the procedures described above, monitoring activities shall revert to the routine program. If the apparent increase is confirmed, WRL shall notify the IEPA before the end of the next business day following the confirmation, and follow up the notification in writing within ten days of such confirmation. The written notification shall provide a narrative explanation of the postulated source of the increase and the supporting rationale.

4.5 SAMPLING QUALITY ASSURANCE PROCEDURES

Appropriate quality assurance procedures will be consistently used whenever sampling and analysis are performed. These procedures include proper sampling, preservation, and chain-of-custody protocol. Only laboratories with appropriate quality assurance procedures will be used to analyze groundwater samples.

4.5.1 FIELD EQUIPMENT CALIBRATION

The pH and conductivity meters will be calibrated before beginning work. Calibration will be checked between each well and a record will be kept in the appropriate bound field notebook or field report forms. The meters will be decontaminated between each groundwater sample by triple rinsing with deionized water.

4.5.2 FIELD BLANKS, TRIP BLANKS, AND DUPLICATES

One field blank and duplicate will be collected for each round of sampling and analyzed for the entire laboratory parameter list. One trip blank will originate at the

laboratory with the VOC vials and be carried with the VOC vials for the entire sampling event. The trip blank will then be analyzed for the appropriate VOCs.

4.5.3 SAMPLING PROCEDURES

Groundwater and leachate sampling will be performed in an appropriate and systematic manner in order to ensure that representative samples are collected. A detailed discussion of the standard operating procedures (SOPs) is provided in Appendix D. A summary of the sampling procedures is provided below.

The following procedures will be performed during each sampling event:

1. Water Elevation Measurement

Measure the distance from the top of the well casing and ground surface to the top of the water in the well to the nearest hundredth (.01) of a foot. The water level indicator is decontaminated between each well following the procedures in Item 5, decontamination.

2. Well Purging

Measure the distance to the bottom of the monitoring well. The depth to the bottom of the well and the depth to water are recorded in a field notebook or on an appropriate form. With this depth measurement and the water depth measurement taken in Item 1 above, determine the volume of water in the well. Remove a volume of water equivalent to at least three times the volume of water in the well with proper stabilization of pH, specific conductance, and temperature. If the well can be bailed or pumped dry prior to stabilization, remove water from the monitoring well until it is dry.

3. Sample Collection

Sampling proceeds from the cleanest well to the most contaminated well to minimize the potential for cross-contamination of the samples. Groundwater samples are collected in the following order; volatiles, semivolatiles, metals, and then any remaining pertinent parameters.

Remove and collect the necessary well water for sample analysis using either a pump constructed of acceptable materials, or a stainless steel bailer. If the well has been pumped dry, wait for the well to recharge sufficiently to allow removal of an adequate sample volume.

Samples are poured directly from the bailer or pump into the sample container. The sample is subjected to minimal agitation to minimize volatilization.

Care is taken to ensure that all headspace is eliminated from the VOC vials (i.e., no air bubbles present in the sample vial).

All samples requiring filtering are treated using a .45 micron filter. Samples are preserved in accordance with the information provided in Appendix D.

4. Perform In-field Tests

Perform the required in-field sample analyses. The tests for specific conductance, temperature, and pH should be performed on unfiltered samples in the field rather than in the laboratory. Observations such as a description of the sample's odor, color, and turbidity should always be made, because these parameters can be used as early warning indicators.

5. Equipment Decontamination

Following collection and preservation of samples, all equipment to be reused must be cleaned by washing with non-phosphate detergent and then triple-rinsing with Type II reagent grade water before being placed into any of the wells and between each well to prevent cross-contamination.

4.5.4 CHAIN-OF-CUSTODY

After collection and identification, the samples will be maintained under chain-of-custody procedures. Sampling personnel are responsible for the care and custody of the samples until they are transferred or properly dispatched. The laboratory or any other person receiving the samples will sign and date the Custody Record. A sample analysis request sheet will accompany the samples to the laboratory. A laboratory log book will be maintained at the laboratory, where all pertinent information about the samples will be recorded.

4.5.5 SAMPLE PRESERVATION AND SHIPMENT

The sample will be preserved using the method required by the laboratory analyzing the samples. Preservation will be required so that the sample remains in the same "state"

until the laboratory analysis is performed. Following preservation and prior to analysis, all samples will be cooled to 4°C and transported to the laboratory as quickly as possible. Lists showing the appropriate preservation techniques and holding times for pertinent parameters are included in Appendix D.

4.5.6 LABORATORY QUALITY ASSURANCE PROCEDURES

The groundwater samples will be submitted to a laboratory that has an acceptable quality assurance program in place. The laboratory quantitative detection limits and the analytical methods for each chemical constituent are included in Appendix E.

4.6 LABORATORY ANALYSES

For each phase of the proposed monitoring programs, laboratory analysis and testing methods will generally and substantially be performed in accordance with those described in the USEPA publication "Test Methods for Evaluating Solid Waste," SW-846, 3rd Edition, revised September 1986 or as revised by future editions. Other references for testing methods may include:

1. "Methods for Chemical Analysis of Water and Wastes," USEPA, EPA 600/4-79-020, revised March 1983,
2. "Test Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater," EPA 600/4-82-057, July 1982,
3. "Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water," USEPA, September 1986; and
4. "Standard Methods for the Examination of Water and Wastewater," APHA-AWWA-WPCF, 16th Edition, 1985 and 1988 Supplement.

Laboratory QA/QC protocols will follow the method requirements found in USEPA Publication SW-846 including calibration checks, control samples and control check

samples, matrix spike and spike duplicate analyses, replicate samples, method blanks, and batch blanks.

For the O&M monitoring and Detection monitoring phases, data quality objectives (DQOs) consistent with the USEPA Level II (field analysis) and III (engineering) will be used. For the Verification monitoring phase, Level IV DQOs will be utilized.

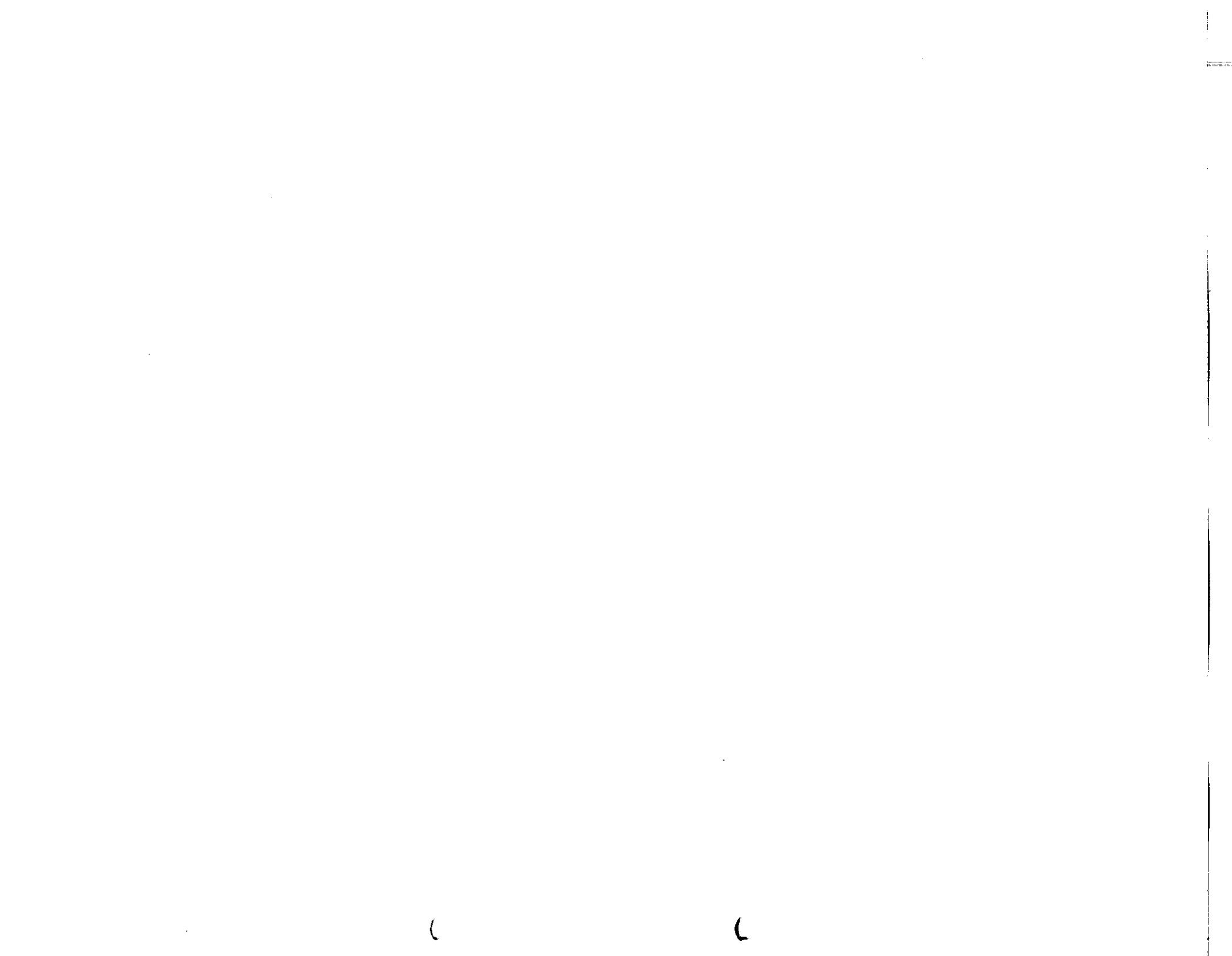
4.7 SAMPLING SCHEDULE

Groundwater monitoring will occur for a minimum period of 30 years following landfill closure. The sampling schedule shall be as follows:

Sampling Quarter	Reporting Date
1. January - February	April 15
2. April - May	July 15
3. July - August	October 15
4. October - November	January 15

5 REFERENCES

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- Yeh, G.T., 1981. AT123D: Analytical Transient One-, Two-, and Three-Dimensional Simulation of Waste Transport in the Aquifer System, ORNL-5602, Oak Ridge National Laboratory, Oak Ridge, Tennessee.



**PLATE 1
OVERSIZED MAP
"Detailed Site Map"
1 PAGE**

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